ORDNANCE

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THE MAGAZINE OF SCIENTIFIC AND INDUSTRIAL PREPAREDNESS

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IN THIS ISSUE

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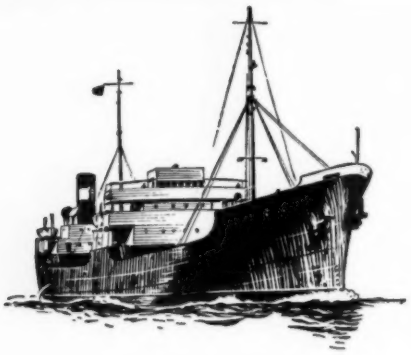
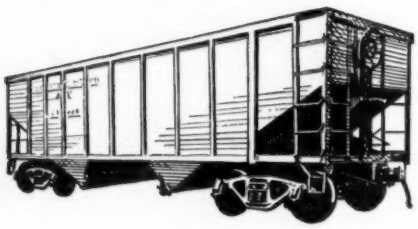
THE JOURNAL
F THE AMERICAN
ORDNANCE
ASSOCIATION
ASHINGTON, D. C.

WILLIAM BAUMBECK

Forty-four years of Ordnance service

Strengthen Fabricated Structures Reduce Bulk and Deadweight Decrease Maintenance Expenses





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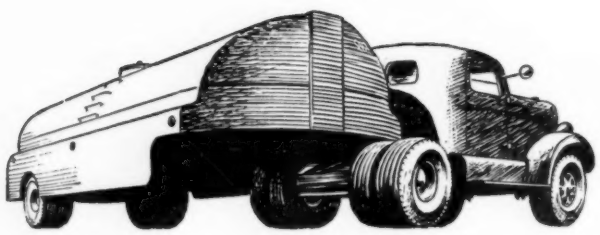

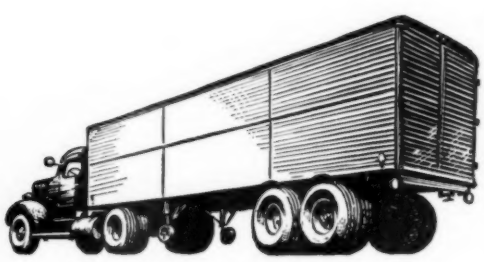

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ORDNANCE

Land • Sea • Air

Magazine of Scientific and Industrial Preparedness

THE JOURNAL OF THE AMERICAN ORDNANCE ASSOCIATION

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• We wish to call the special attention of our readers to the article, "Soviet Armor," by Col. Robert J. Icks on page 171 of this issue.

For many years Colonel Icks, both as an Ordnance Reserve officer and as a civilian, has made an intensive study of combat vehicles of all types and is considered an outstanding authority in this field.

In the present article Colonel Icks has made a comprehensive analysis of the development of Russian tanks from their earliest beginnings in World War I to the present day.

We believe this is one of the few authentic stories of Soviet armor to be published recently and one that is of especial timeliness.

• Willy Ley, internationally known rocket expert, also writes in this issue on some of the factors preventing the unlimited use of the rocket as a long-range missile, while Dr. Karl Z. Morgan of the Oak Ridge National Laboratory, Oak Ridge, Tenn., writes on the measures necessary for protection of personnel from atomic radiation. Both these articles are of particular significance.

• In coming issues there will be an interesting article on the helicopter by Frank N. Piasecki, president of the Piasecki Helicopter Corporation; also an account of Phil Sharpe's "homemade" counter chronograph for determining bullet velocities.

Watch for these and other informative articles in your issues of ORDNANCE.

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ONE of the principal functions of the American Ordnance Association is "to provide, when required, the services of competent committees to investigate and report upon special ordnance subjects and to encourage programs for the adequate understanding of the procurement, production, and other untold phases of national preparedness including those new developments of logistics necessitated by modern military strategy and tactics."

To meet this obligation to our national defense, the Association has in operation a number of National Divisions under the leadership of civilian experts who are well qualified to direct their activities. In addition, there are a number of committees on special subjects, some of which are of a continuing nature. Others, for the performance of a specific undertaking, are noncontinuing. All are devoted primarily to the advancement of engineering practices and production techniques relating to particular fields of ordnance.

Following are the personnel of the various Divisions, committees, and subcommittees that have thus far been activated.

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ABRASIVES COMMITTEE

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MACHINE TOOL COMMITTEE

Walter Tangeman, Cincinnati Milling Machine Company, Cincinnati, Ohio, *chairman;* Herbert H. Pease, New Britain Machine Company, New Britain, Conn.; A. H. Eggers, Greenlee Brothers & Company, Rockford, Ill.; Haviland Wright, Wright & Gade Tool Company, Philadelphia, Pa.; Richard E. LeBlond, R. K. LeBlond Machine Tool Company, Cincinnati, Ohio; Richard A. Heald, Heald Machine Company, Worcester, Mass.; George H. Johnson, Gisholt Machine Company, Madison, Wis.

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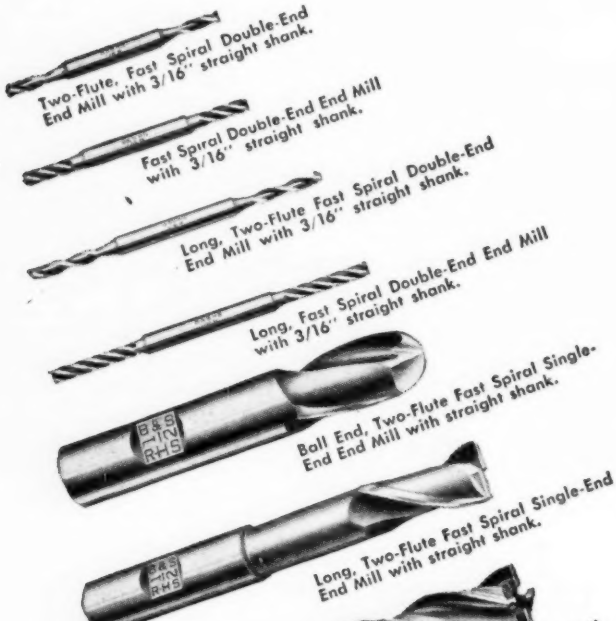
Two-Flute, Fast Spiral Double-End End Mill with 3/16" straight shank.
Fast Spiral Double-End End Mill with 3/16" straight shank.
Long, Two-Flute Fast Spiral Double-End End Mill with 3/16" straight shank.
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Ball End, Two-Flute Fast Spiral Single-End End Mill with straight shank.
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Long, Fast Spiral Single-End End Mill with straight shank.
Extra Long, Fast Spiral Single-End End Mill with straight shank.

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New Developments

LAND

ORDNANCE TO ADVISE GUARD

The Department of the Army has authorized the assignment of thirty-eight officers and thirty-eight enlisted men as Ordnance technical advisers to the senior Army instructors on duty with the National Guard. They will be assigned to those States which are not allocated Ordnance instructors. At the present time thirteen Regular Army officers and thirteen enlisted men are assigned as instructors.

ROCKET PROGRESS

An enlightening summary of recent progress made by scientists in utilizing war heads of German V-2 rockets to obtain secrets of the upper atmosphere has been prepared by Dr. James A. Van Allen, a staff member of the Applied Physics Laboratory of Johns Hopkins University and chairman of the Upper Atmosphere Rocket Research Panel. Dr. Allen listed the following as some of the principal results obtained from V-2 experiments:

1. Measurements of the cosmic-ray intensity above the atmosphere.
2. The feasibility of high-altitude aërial reconnaissance from rockets.
3. Measurements on atmospheric temperature and pressure to about 120 kilometers.
4. Recording of data on the index of refraction for certain frequencies of radio waves in the E layer of the ionosphere.
5. Discovery of a preliminary distribution curve of ozone versus altitude.

SYNTHETIC QUARTZ

Clear, sparkling crystals of real quartz, identical in every way to those produced only by the processes of nature, are now being grown inside bomblike steel "test tubes" by a group of scientists at Bell Telephone Laboratories.

The material from which the quartz crystals are grown is a finely powdered form of silica, a common chemical compound which looks something like granulated sugar. This is placed in the bottom of the steel bomb and an aqueous alkaline solution is added. The seed plate, a thin wafer of quartz, is suspended at the top of the bomb; the bomb is then sealed and placed in a furnace.

Under pressures exceeding 15,000 pounds per square inch and at temperatures of about 750 degrees Fahrenheit, the silica dissolves. In its dissolved state, it rises to the cooler part of the bomb and is deposited on the seed plate, molecule upon molecule, in perfectly regular order until all of it is in the form of a single clear crystal.

ARCTIC FASHIONS

Discovering that it is the wind as much as the cold that defeats men in the far North, American and Canadian scientists have devised new clothing that will completely insulate soldiers against the rigors of the Arctic. In contrast to the Eskimos, white men in the past put on layers of clothing which kept out the cold but kept in the sweat, and if the sweat froze, so did the man. Now the soldier of the snow country will test new equipment based on the "vapor-barrier" principle. First, there will be a netlike string vest next to the skin. Over it will go parkas of mohair and rubberized nylon, incorporating methods

Three GUIDING STARS of modern navigation . . .

★The Sperry GYRO-COMPASS with its non-magnetic, true north indications is the modern mariner's guide for trustworthy, accurate *direction.*

★Sperry RADAR is his *safeguard* and *protection* when visibility is poor—permitting his ship to operate on regular schedule through fog, smoke, rain, darkness.

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This group of three Sperry instruments—with their complementary functions—equips a ship with the most modern means of making navigation safer, simpler and more efficient.

Every one of these Sperry products offers superior features: In the Sperry GYRO-COMPASS, ruggedness and reliability . . . In Sperry RADAR, a Gyro-Compass-controlled image and a simple operating technique . . . In Sperry LORAN, advanced design and exceptional ease of operation with the exclusive Time Difference Meter.

All are backed by the Sperry world-wide service organization.

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DIVISION OF THE SPERRY CORPORATION • GREAT NECK, N.Y.

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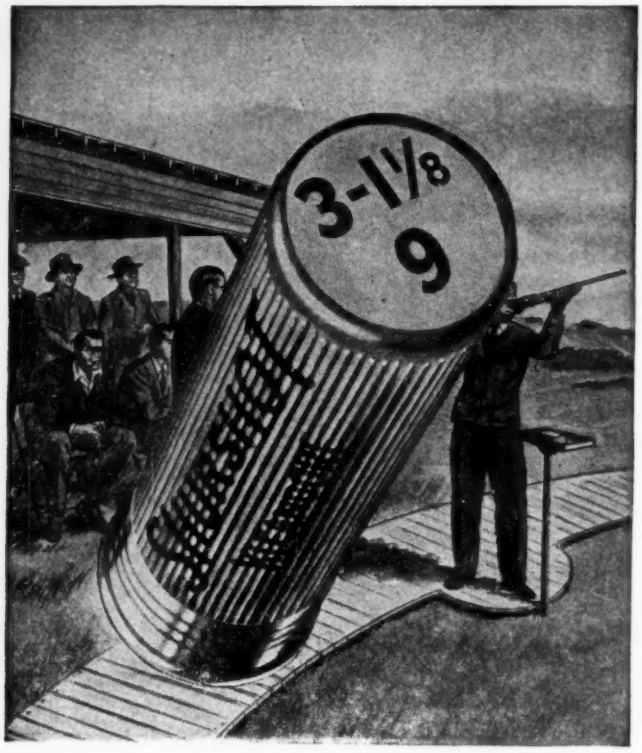
For Higher Scores at Skeet



Shoot Remington "Shur Shot" Shells with New Flat Top Crimp

No more blown patterns! That's why Remington Shur Shot shells with the Remington Flat Top Crimp make skeet even more fun—scores even higher. This remarkable development by Remington is constructed so that there is nothing to obstruct the shot charge. The Remington Flat Top Crimp leaves no "holes" or thin areas in the pattern for targets to slip through. Remington Shur Shot shells back up your shooting skill every time.

Remington Shur Shot shells have exclusive Kleanbore non-corrosive priming and uniform velocity to get the shot pattern out there *fast*. Also exclusive green, corrugated bodies, progressive burning powder, improved wet-proofing, and patented top seal.

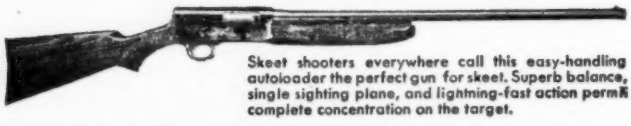
Made in 12-, 16-, and 20-gauge skeet loads and 12-gauge trap. For free literature, write Remington Arms Company, Inc., Bridgeport 2, Conn.

Remington

DU PONT

"If It's Remington—It's Right!"

Here's the Smooth-Swinging "SPORTSMAN"



Skeet shooters everywhere call this easy-handling autoloader the perfect gun for skeet. Superb balance, single sighting plane, and lightning-fast action permit complete concentration on the target.

Kleanbore and Sportsman are Reg. U. S. Pat. Off.; Shur Shot is a trade mark of Remington Arms Co., Inc.

New Developments

of controlling the air flow around the body. In this manner, white men will be able to stand the deadly chilling winds as well as the Eskimos.

ALL-WEATHER GREASES

A convoy of twelve 2½-ton Army trucks left Aberdeen Proving Ground, Md., recently on "Operation Greaseball"—a journey which will take them through the blistering heat of California deserts and the bitter cold of an Alaskan winter.

In announcing the trip, the Ordnance Department said that the data to be obtained are expected to have great value for the civilian motorist as well as tremendous military significance.

The test run, which will cover about 20,000 miles and continue until the spring of 1949, is intended to prove up, in rugged practical operation, new automotive greases developed by the Army Ordnance Department and the petroleum industry. Six greases will be tested on the trip, each type in two of the trucks. When and if they are commercialized, the all-weather greases may prove a boon to motorists for year-round operation in some of our northern States.

NEW SYNTHETIC RUBBER

Synthetic rubber for tire treads, soon to be available and said to increase wear more than thirty per cent over the best natural rubber treads, may help make America independent of the natural imported product in case of another emergency. The key to the manufacture of the new rubber is the fact that it is produced at zero Fahrenheit temperature. Formerly Buna S (GR-S) rubber was made at a standard temperature of 122 degrees. The superiority of the new rubber is due to the fact that its molecules are more uniform than those in other rubbers.

QUALITY CONTROL COURSES

Reflecting the increasing postwar interest in quality control and its sampling and statistical procedures, a series of educational conferences on the subject is being offered at the Federal Products Corporation plant in Providence, R. I. During the last two years twelve of these conferences have been held at Providence. More than 400 men have been sent to these conferences from some 250 plants and several arsenals and Ordnance districts, representing areas from Maine to Iowa, Michigan to Tennessee. The conferences respond to the demand for wider training of supervision personnel for applying the most recent proven quality-control methods, including practical statistical techniques.

TITANIUM METAL

The Du Pont Company has announced that it has begun the small-scale manufacture of titanium metal, a new basic raw material for industrial development. A pilot unit of one hundred pounds' daily capacity has been successfully placed in operation at the Newport, Del., plant of the pigments department, marking the first time ductile titanium metal has been produced for commercial exploration.

The silver-white metal is light and strong. It is highly resistant to corrosion and has a higher melting point than the commonly used metals. It is comparable to stainless steel in strength and corrosion resistance, but weighs only a little more than half as much per unit of volume. It is less than twice as heavy as aluminum, but several times as strong, in bars of comparable dimensions.

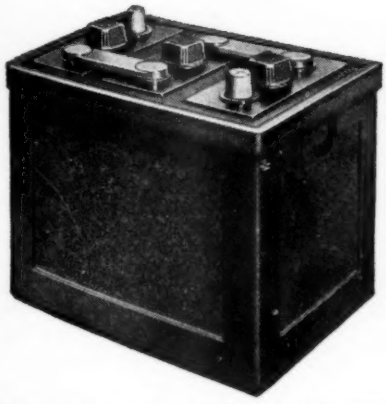
OIL WELL "BAZOOKA"

The principles used to make the wartime bazooka such an effective weapon have been applied successfully to problems of oil wells and oil-well drilling. By taking advantage of the tremendous blasting power generated by the shaped-charge explosives, Welex Jet Services of Fort Worth, Tex., has devised

Which is really Ginger Rogers?

FAMOUS MOTION PICTURE STAR
(See answer below)

Batteries also look alike, but Auto-Lite Sta-ful Batteries



need water only 3 times a year . . .

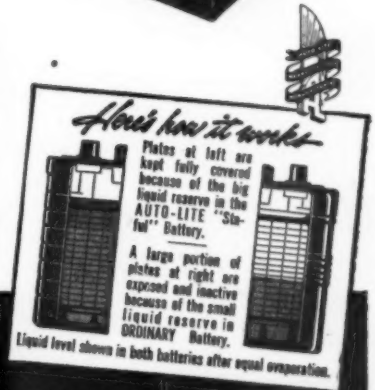
IN NORMAL CAR USE

NO MATTER how much batteries look alike score yourself 100% right when you pick a new Auto-Lite "Sta-ful", the sensational battery that needs water only 3 times a year in normal car use.

And you are 100% right if you picked the girl at the left as Ginger Rogers, famous motion picture star. The girl at the right is Callie Goode, of East 46th Street, New York City, who says news photographers are constantly mistaking her for Miss Rogers.

So if batteries look alike to you, be wise—buy an Auto-Lite "Sta-ful". Money cannot buy a better battery for your car.

AUTO-LITE BATTERY CORPORATION
Toledo 1 Ohio


Here's how it works
Plates at left are kept fully covered because of the big liquid reserve in the AUTO-LITE "Sta-ful" Battery.
A large portion of plates at right are exposed and inactive because of the small liquid reserve in ORDINARY Battery.
Liquid level shown in both batteries after equal evaporation.

AUTO-LITE BATTERIES

TUNE IN THE AUTO-LITE RADIO SHOW "SUSPENSE!"... RADIO ADVENTURE AT ITS GREATEST... THURSDAYS, 9:00 P. M., E. S. T. ON CBS.

METALWORKING MACHINERY

Cold Headers for Bolts, Screws, etc.

Bolt Head Trimmers

Screw Thread Rolling Machines

Nut Forming Machines

Nut Tapping Machines

Screw Slotters

Rivet Drillers

Power Presses of all Kinds

Eyelet Machines

Small Arms Ammunition Machines

Collapsible Tube Machines

Thread Rolling Machines for Shells

Wire Drawing Machines

Rolling Mills for Sheets and Strips

Rod and Tube Mills

Flatteners and Straighteners

Gang Slitting Machines

Swagers, Pointers, Coilers, Winders, etc.

Special and Miscellaneous Machines

WATERBURY FARREL
FOUNDRY AND MACHINE COMPANY
Waterbury Connecticut, U. S. A.
SALES OFFICES:
CHICAGO CLEVELAND NEWARK, N. J.

for the oil industry a means of greater penetration into oil-bearing stratas of earth through oil-well casings and cement. Du Pont makes these jet charges exclusively for Welex.

SYNTHETIC MICA

A synthetic mica has been produced for the first time with the desirable characteristics of natural mica, a strategic stockpile material used in electronic equipment. The synthetic material is being produced on a pilot-plant scale under a coördinated research program sponsored by the Office of Naval Research, the Army Signal Corps, and the Navy Bureau of Ships.

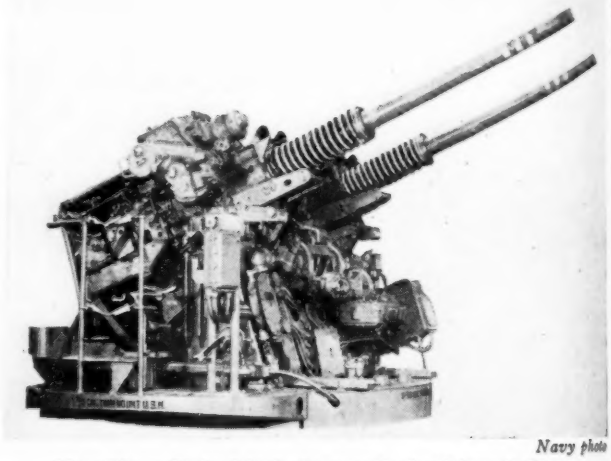
SEA

NAVAL ORDNANCE DEVELOPMENTS

Since V-J Day the Navy has been supporting an extensive fundamental research program which already is paying dividends in important new scientific discoveries.

New 8-inch turret guns, developed since V-J Day as part of the Bureau of Ordnance program of adapting rapid, automatic features to large guns, will fire at battle ranges approximately four times faster than any gun of the same or larger caliber. Automatic from ammunition-handling rooms to gun muzzles, the new 8-inch batteries eject cartridge cases from the mounts—powder bags having been abandoned in favor of cartridge cases to achieve the desired high rate of fire.

The principle of automatic fire also has been applied to a 6-inch, dual-purpose gun, and a new 3-inch, 50-caliber antiaircraft weapon. The rate of fire of the new 6-inch gun, the first



Navy photo

New Navy Twin 3-inch Automatic Antiaircraft Guns.

rapid-fire antiaircraft mount of its caliber, has exceeded by a wide margin its original design specifications.

Newer aircraft fire-control systems to give further improved gunnery and bombing accuracy also are under development. Guns and mounts are still being redesigned and improved to give faster and more accurate hitting power. New rockets are being designed to have greatly increased velocity, more effective heads, and improved accuracy in flight. Other research and development projects being vigorously pursued include guided missiles, improved torpedoes, improved mines, and antisubmarine weapons.

NEW HELICOPTER

A new Sikorsky helicopter for use on aircraft carriers, battleships, and cruisers is undergoing tests. It will have all-metal blades which lend themselves to de-icing, rather than the conventional metal-framed ones. A hatch in the cabin floor will

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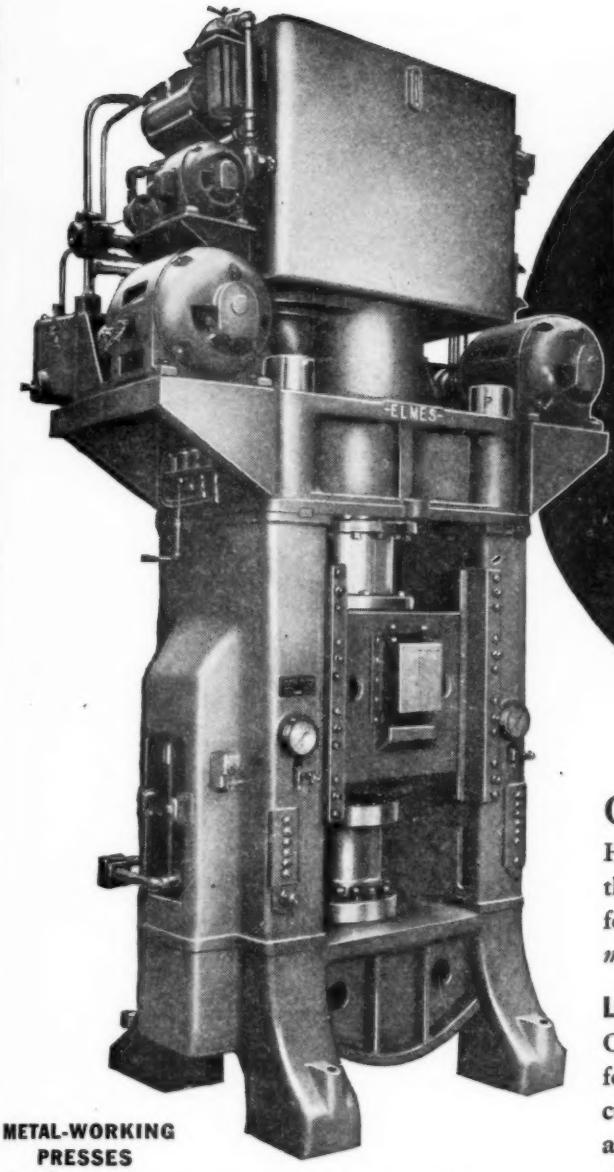

METAL-WORKING PRESSES

This Elmes drawing and forming press delivers production-shop speed with job-shop versatility. Stroke can be as little as 3". Pressure can be reduced as low as 1/7 to 1/10 of rating. Automatic slide reversal is actuated either by ram travel or pressure, even when "inching" at pressing speed or slower. Choice of four operating cycles with pressures from 30 to 350 tons, all on automatic control. This particular press has 150 tons on the ram return for extra-heavy stripping.

SPECIAL-PURPOSE ELMES PRESSES FOR UNUSUAL REQUIREMENTS

Elmes engineering-for-the-job makes many tough jobs easy. The "Duplex Tube Reducer," at right, delivers 600 pieces per hour with a 26" length of tube reduction. Powered by two 125-h.p. motors, it exerts a 60-ton pressure. Each end of the press performs the same or separate functions. Chute feed, transfer, stripping, and discharge all are automatic, and everything is interlocked for trouble-free, positive sequence. Press is illustrated without enclosure to show arrangement of mechanism.

Quick work is *good* work when it's done on Elmes Hydraulic Presses. Pressing speed is controlled by the operator to *exactly suit* each need. Hydraulic force that is swift, yet responsive, keeps rejects *remarkably* low.

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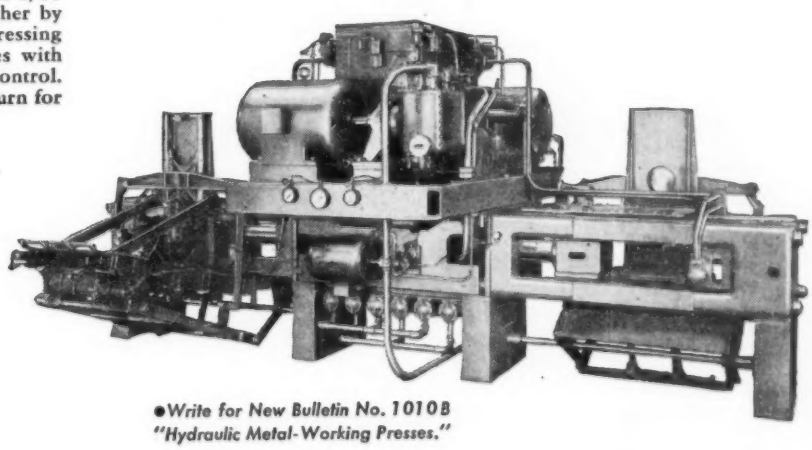

•*Write for New Bulletin No. 1010B "Hydraulic Metal-Working Presses."*

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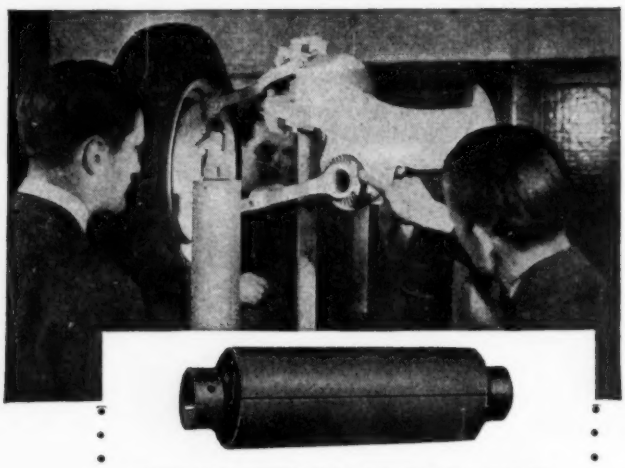
WITH TORSILASTIC RUBBER SPRINGS



TORSILASTIC RUBBER SPRING made by bonding a rubber cylinder with an inner Shelby Seamless Steel Tube and an outer metal shell.

THE new Torsilastic rubber spring developed and manufactured by one of the large rubber companies,* is an ingenious device, the inner tube of which is a SHELBY Seamless Steel Tube with rubber permanently bonded to it and the metal of the outer shell. The body of the vehicle is suspended on rubber which results in a much smoother ride than conventional spring design.

More than 500,000 of these rubber springs were used on heavy military vehicles such as "Water Buffalos" and "Beach Busters" and today they are being built into heavy buses.

This type of spring needs no lubrication and is highly resistant to salt water. Sand doesn't damage its action.

The Seamless Tubing used for the Torsilastic spring had to be light but exceptionally strong with a high degree of dimensional accuracy. The metal had to be able to withstand constant shock and fatigue under thousands of pounds of weight.

SHELBY Tubing has proved completely satisfactory.

In military equipment of all kinds, where strength and light weight are most important, SHELBY Tubing often can be used to replace heavy castings and forgings to save extensive machining operations. Sizes range from ⅜ inch to 10½ O.D. inches and in wall thickness from .035 to 1.500 inches cold drawn. Write for complete details and analyses available.

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UNITED STATES STEEL

New Developments

make air-sea rescue easier and will facilitate cargo loading by permitting installation of a hoist.

NAVY ROCKET RADIO

A tiny telemetering system weighing only a few pounds and capable of transmitting 24 different types of information simultaneously from a rocket traveling at nearly 3,000 miles an hour has been successfully tested by the Navy Department at White Sands, N. Mex.

Installed aboard the Navy's "Aerobee," the new unit functioned satisfactorily at an altitude of 71.78 miles above the earth at a maximum velocity of 2,830 miles an hour. The instrument radioed to recording instruments on the ground data concerning flight characteristics, motor performance, cosmic-ray intensity, quality of sunlight above the atmospheric blanket, and changes in the strength of the earth's magnetic field.

SUPERCARRIER

The Navy's projected 65,000-ton carrier will carry more than a score of 100,000-pound 4-engined planes, will have a designed speed of about 33 knots, and will displace, it is expected, about 80,000 tons with full load.

It will have an armored flight deck and other armor and will bristle with antiaircraft guns of improved design. Its high-pressure, high-temperature boilers will supply steam turbines capable of producing about 280,000 horsepower. Its over-all length will be 1,090 feet; its beam, 130 feet. The new carrier's estimated cost will be about $124,000,000 at time of completion. At peacetime tempo the building would take forty-six months. By the time this supercarrier is completed the Navy expects to have available the 4-engined 100,000-pound aircraft, probably powered by turbine-driven propellers, which will be capable of top speeds of 400 to 450 knots, with operating radii of 1,500 to 2,000 miles.

NAVY TEST CENTER

In keeping with the accelerated emphasis on guided missiles, the Navy plans a new testing station at Point Mugu, Calif., expecting a total expenditure of $30,000,000 on expanding the existing installation to permit the testing of all types of guided missiles over water.

UNDERWATER PHOTOGRAPHS

A method of taking underwater photographs that reveal the flow patterns about surface vessels has been developed by the Experimental Towing Tank Laboratory of Stevens Institute of Technology. As a research tool, such photographs show promise of providing a valuable aid to the understanding of flow phenomena around a body. The method, similar to the "tuft" technique used in wind-tunnel and flight testing of aircraft, utilizes limp threads attached to the model itself, or to fine wires extending from it. Specifically, it can be employed in locating the optimum position of the rudder and the propeller and such appendages as bilge keels, scoops, overflow pipes and propeller struts or bossings.

AIR

AIR FORCE LINE-UP

The United States Air Force now has about 400 B-29's in operation, 400 more which are used as "spares," about 500 that are protected with grease and other material against rust but can be put into flying shape quickly, and approximately 1,500 in plastic "cocoons" for long storage. Meanwhile, the operating fleet is being built up slowly with B-50's, successors to the wartime B-29's, and with the first production models of the big B-36.

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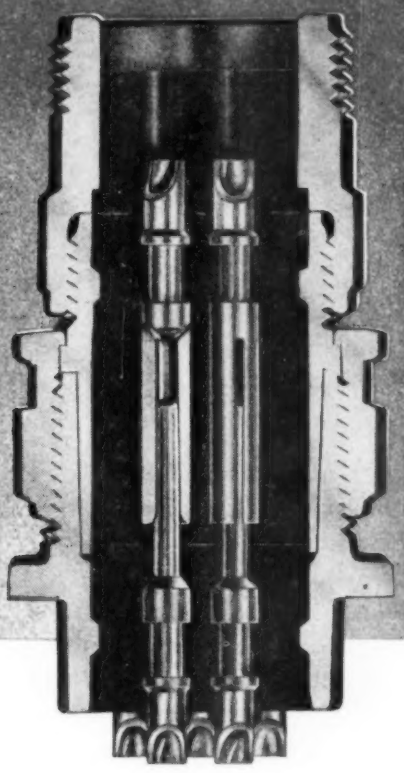
the finest money can buy!



these are the features THAT HAVE MADE IT *the* QUALITY CONNECTOR

- Moisture-proof, Pressure-tight
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PRACTICALLY NO VOLTAGE DROP!

Contacts that carry maximum currents with a minimum voltage drop are only part of the many new advantages you get with Bendix-Scintilla* Electrical Connectors. The use of "Scinflex" dielectric material, an exclusive new Bendix-Scintilla development of outstanding stability, increases flashover and creepage distances. In temperature extremes, from −67° F. to +300° F., performance is remarkable. Dielectric strength is never less than 300 volts per mil. Bendix-Scintilla Connectors have fewer parts than any other connector on the market—and that means lower maintenance costs and better performance. *REG. U.S. PAT. OFF.

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● Better control of quenching temperatures improves the heat-treating process, gives better physical properties to steel, increases production with fewer rejections.

That is the experience with the use of NIAGARA AERO HEAT EXCHANGERS, providing faster and more accurate cooling to specified temperatures for quench baths, either oil or water. Production is increased; unit costs are lowered. Commercial heat treaters have increased profits; heat treating departments have contributed savings.

NIAGARA AERO HEAT EXCHANGERS are built in a range of sizes to fit any installation. Saving of cooling water quickly pays for the equipment.

Other applications include jacket water temperature control for process equipment or engines, cutting oils, lubricants, hydraulic oils, transformers, electronic sets, controlled atmospheres, compressed air or gas cooling.

Write for Bulletin 96-o

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Over 30 Years of Service in Industrial Air Engineering

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INDUSTRIAL COOLING HEATING • DRYING
NIAGARA
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

New Developments

The following new Air Force planes were disclosed recently in *American Aviation Daily:*

McDonnell XF-88, a long-range twin-engined jet fighter with a top speed well over 600 miles an hour.

Northrop XF-89, a 2-engined all-weather jet fighter of a flying-wing type with a speed approaching 600 miles an hour.

Lockheed XF-90, a 2-engined jet fighter with considerable range and normal top speed of over 600 miles an hour. It will carry rockets to give it emergency speed for brief periods.

Republic XF-91, a short-range interceptor fighter for local defense, able to fly at sonic speed at sea level and much faster at high altitude. It has a jet engine for take-off, but carries rocket power for fast climbing and emergency speed bursts. It can climb as much as six or seven miles in a minute.

Consolidated Vultee XF-92, another interceptor designed to climb 5 miles a minute and fly level at more than 700 miles an hour. In addition to a jet engine it will have rocket power for bursts of speed well above the sonic range.

North American's F-86A, now being manufactured, will be the first supersonic aircraft to go into quantity production.

WIRE-LAYING HELICOPTER

The feasibility of laying telephone wire for military purposes by helicopter has been demonstrated by Signal Corps engineers through recent tests at the Signal Corps Engineering Laboratories. The tests also demonstrated that helicopters could be used advantageously for the inspection of field telephone lines. To determine the accuracy with which wire may be payed out, a course was plotted and a marker placed in an open meadow. Wire was then successfully laid within a yard of the marker and between trees separated by a few feet.

GLIDER "ANCHOR"

Air Force gliders can now be brought to a quick stop on short landing fields. When an incoming glider is a few feet off the ground the pilot fires two "guns"—steel tubes filled with a black-powder charge and set at an angle on both sides of the fuselage. The detonation of the charge drives two 48-inch steel spikes deep into the ground. Attached to the spikes is a 54-foot length of undressed nylon rope (which can stretch 400 per cent of its length) that is payed out from the fast-moving craft until it gently snubs the glider to a halt in a space from 200 to 300 feet.

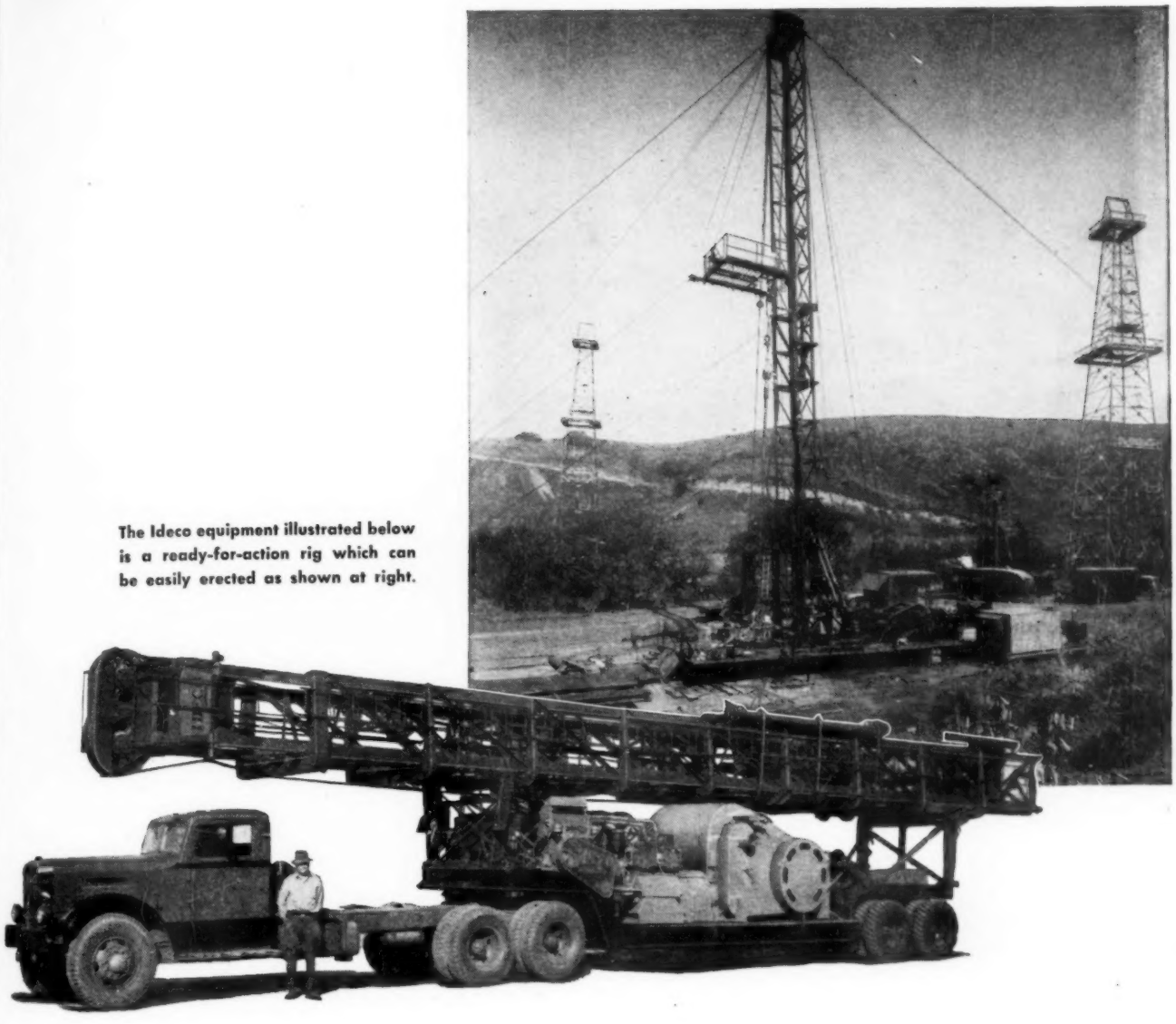
BRIGHTEST FOG LIGHTS

The world's brightest lights will be tested at the armed forces Landing Aids Experiment Station, Arcata, Calif., which is considered the foggiest spot in America. The U. S. Air Force has ordered for Arcata a system of newly developed all-weather approach lights which are designed to penetrate "zero-zero" fog for at least 1,000 feet. The system will include 36 of the world's brightest lights—3,300,000,000 peak candlepower each—and 35 lights of somewhat lesser brilliance. Lined up in a row two-thirds of a mile long, the seventy-one lights will produce lightninglike flashes to guide fog-bound pilots to the Arcata airfield runway. When used in conjunction with the instrument-landing system, the new approach lights will make possible nearly normal visual landings despite the poorest visibility conditions.

CERAMIC JET NOZZLES

More dependable ram-jet, pulse-jet, turbo-jet, and rocket engines will result from investigations under way to develop ceramic coatings for high-temperature metals to protect them from the excessive heat in these devices used in high-speed planes, guided missiles, and rockets.

The studies are being conducted by the National Bureau of Standards under the sponsorship and with the financial aid of the National Advisory Committee for Aëronautics.



The Ideco equipment illustrated below is a ready-for-action rig which can be easily erected as shown at right.

Peace insurance begins on jobs like this!

The bigger they are—the transport jobs so vital today to America's commerce and industry—the bigger the trucks it takes to get them done. Biggest of all, to you, is the *power for peace* this trend exerts:

All the world knows that each super-truck is a potential military machine; that every big civilian transport development shows the way to bigger and finer military equipment; that every man-hour invested in such development strengthens America's defense capabilities.

Wherever engine-propelled wheels turn, on the road or off, Timken-Detroit Axles continue unceasingly to prove themselves "The Accepted Standard" for heavy-duty vehicles of every kind. For more than 40 years, Timken-Detroit research, engineering and production have played a major part in the progress of heavy transport—a *continuing program* of peace insurance!

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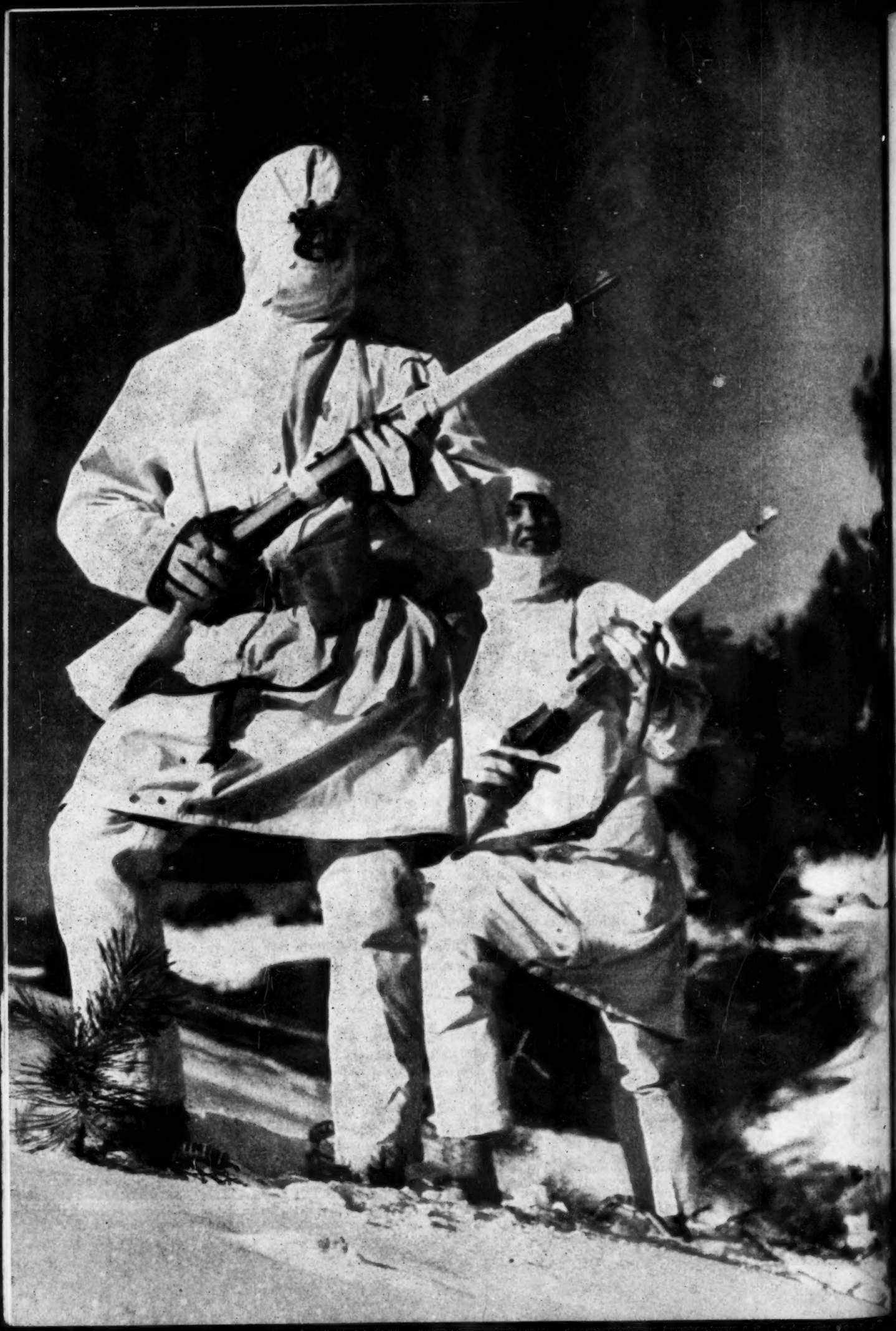


Ordnance Loyalty

William Baumbeck Symbolizes a Great Civilian Tradition

THE modern world is cancerous with suspicion and distrust. This is true not only in international affairs, where East confronts West in somber and unrelieved hostility, but also in the more intimate daily relationships of men everywhere.

Some we thought worthy of the highest trust have proved faithless to that trust. A few outwardly respectable citizens have been found out, in recent months, to be whitened sepulchers. Some of those who professed to love America have, in a critical hour, betrayed her.

This slow disintegration of human faith in our fellow citizens and co-workers can only be arrested by calling attention to demonstrated integrity, thereby holding aloft a standard of honesty, devotion, and self-sacrifice to which all men of good will can re-dedicate themselves.

William Baumbeck, whose photograph appears on the front cover of this issue, is chief superintendent of production at Rock Island Arsenal, Ill. He is retiring after forty-four years of loyal and faithful service to Ordnance and to the Nation.

We delight to honor him as a beloved friend, as a technical expert of the highest attainments, and as a leader of men who devoted the greater part of his exemplary life to the cause of preparedness and peace.

But above all else we pay tribute to William Baumbeck for his resolute and unswerving loyalty to American democratic principles; for his modest, generous, and unstinting service to his country in war and peace.

In inscribing the name of William Baumbeck among the Ordnance immortals, we feel that we are likewise bestowing an accolade of well-merited praise on all civilian Ordnance workers who, imitating his inspiring example, are today patriotically and unselfishly devoting themselves to national security.

> **"Just as England and the freedom-loving peoples of the world owe a great debt of gratitude to Britain's RAF, so also are America and the United Nations tremendously indebted to our arsenal military and civilian personnel who kept alive the science of munitions manufacture and who passed on to American industry the techniques required initially to produce, in gigantic quantities, the armament that has given all of us another and perhaps a final opportunity to build a better world."—Lieut. Gen. L. H. Campbell, Jr., *Chief of Ordnance, 1942-1946.***

Genuine loyalty, like true love, is confirmed and strengthened in adversity. We have recently become accustomed to think in terms of billion-dollar appropriations for our armed forces. But if we go back a quarter of a century we will discover that total annual Ordnance appropriations were less than seven million dollars. In those lean and adverse years, Ordnance service frequently required considerable sacrifice.

One of the highest tributes ever paid an Ordnance worker was penned for William Baumbeck by Lieut. Gen. L. H. Campbell, Jr., wartime Chief of Ordnance, in his memorable book, "The Industry-Ordnance Team."

"One of the saddest days of my life," General Campbell wrote, "occurred when I was stationed at Rock Island Arsenal in 1923. We received word from Washington of another slash in Ordnance appropriations and were compelled to make drastic curtailments. We had only two unpleasant alternatives—to discharge many of our younger civilian employees or to cut the salaries of our veteran workers.

"If we fired the youngsters, the armament art in America would eventually die out. It therefore became necessary to inform those older men who had rendered loyal and faithful service to their country for many years of our grave dilemma. We talked the matter over with them and they agreed, like the good Ordnance civilian soldiers they were, to accept cuts in their yearly salaries ranging up to a thousand dollars. They agreed with us that only in this way would it be possible to maintain continuity in our work and to hand down to the next generation the priceless unwritten lore of armament design and manufacture.

"Every Regular Ordnance officer has a deep personal affection for our six old-line arsenals and their civilian personnel. Those of us who have known and served with such fine men as Mr. William Baumbeck, superintendent of Rock Island Arsenal, cannot help feeling admiration and respect for these great craftsmen. We have studied in these arsenals, worked in their shops, and learned from master craftsmen the secrets of one of the most highly specialized professions in the world."

WERE it not for the William Baumbecks in our arsenals, the defeat of the Axis powers would have been impossible. Industry alone, without arsenal know-how, could not have mass produced sorely needed weapons and ammunition quickly and efficiently. The transmission to our industrial plants of the essential know-how depended upon arsenal employees and, in particular, upon such men as William Baumbeck whose salaries, a few years earlier, had been slashed to the bone.

If they had resigned, back in those lean years, rather than suffer severe salary cuts, the loss to the Nation would have been irreparable.

If loyalty is best tested in the fires of adversity, then certainly the true steel of men like William Baumbeck is deserving of the highest tribute that the armed forces and a grateful Nation can bestow.

MEN IN WHITE battle snow and ice as the new U. S. Army trains its troops to fight and live under severe climatic conditions (Army photograph).

Time and World Peace

The Crucial Factor in the Race for Military Dominance

by
John A. Giles

"As time moves on, we will become progressively better equipped to fight"

POSSESSION of the atom bomb notwithstanding, additional time favors the United States if war with Soviet Russia is inevitable, according to the consensus of our military leaders. However, they admit that the time factor can be argued either way.

At the outset it may be well to emphasize that most top Government officials will not concede the inevitability of conflict with Russia. It is a fact that Russia's expansionist moves to date have been more or less in the formation of what amounts to buffer states. The fact remains, however, that the inherent Communist political philosophy is world domination.

Russia did show a belligerent attitude in Czechoslovakia, and Adm. Sidney W. Souers, executive secretary of the National Security Council, characterized its as a "quasi-military move."

"It at least showed a nervousness on her part to force the issue when she did," the admiral told a House Appropriations subcommittee. "Her determination to line up Finland indicated she was making military moves. Her actions in Berlin would indicate that she was going to press forward as much as she can. My own feeling is Russia means to carry forward short of war."

But the possibility of war has caused some long and serious studies by the Joint Chiefs of Staff and at the War College. They have included the question of whether or not it would pay the Red legions to move now rather than wait until later.

Secretary of Defense Forrestal has said that "time flows against us" until "the strength of our friends becomes sufficiently imposing." He and others see the European recovery program as the greatest single time factor in our favor. For these nations, including Britain, which always have provided us with a cushion of time, were exhausted in defeating our German and Japanese enemies.

Russian Timetable

Military leaders point out that the Red Army today probably could overrun the whole of Europe and a good part of the Middle East in a short time while we sat by virtually helpless. Here is the way some strategists figure the Russian timetable, even with resistance: Gibraltar, six months; Persian Gulf, six months; Yellow River in China, three months; Korea, a matter of days.

What would make the fourteen members of the Politburo in Moscow decide to conquer that area now rather than wait until they have the atom bomb if world domination is the actual objective?

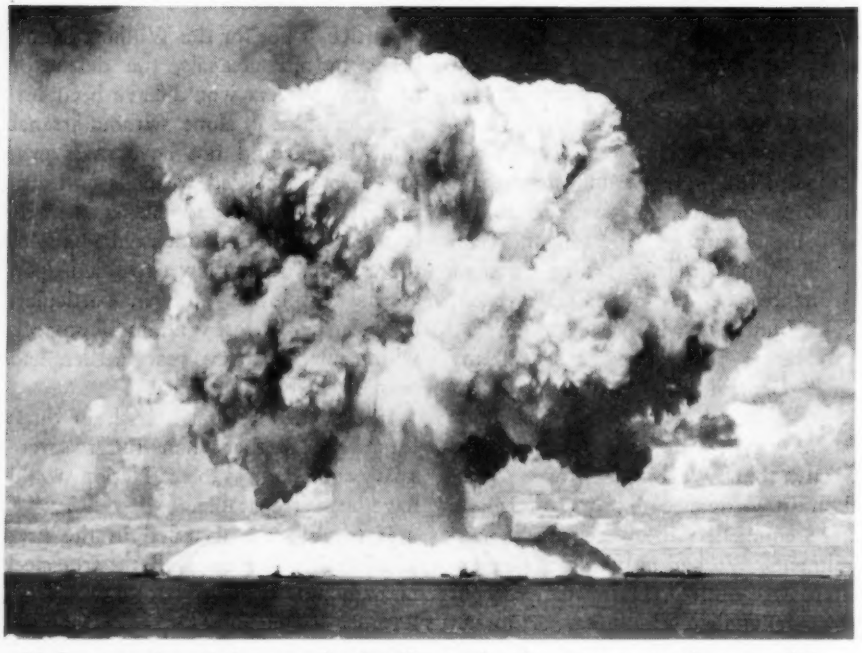
One factor known to strategists is that the Russians now have vast stores of rapidly deteriorating munitions and equipment—some, perhaps, left over from our own Lend-Lease supplies. Why allow those supplies to go down the drain?

In addition, according to Secretary of the Navy Sullivan, the Russians now have "more than 250 operating submarines and undoubtedly on short notice are capable of producing a large number of the latest design, vastly superior to any operated by the German Navy during World War II."

The House Committee on Foreign Affairs, reporting on emergency foreign aid, stated that the Soviet armed forces now total 4,050,000, of which approximately 2,600,000 are ground troops. It also estimated that Russia had 450,000 airmen and 14,000 planes. These forces are vastly superior in numbers to those of the United States at the present time.

Another factor which weighs heavily in favor of immediate Soviet action is that a dictatorship must always have victories to show its people, and when the infiltration technique comes to a standstill—which it shows signs of doing in the case of the Communists—military moves ofttimes follow.

Wars are usually caused by the assurance on the part of an aggressive power that it possesses sufficient superiority to overcome any possible obstacles



U. S. possession of the atom bomb still remains the most potent threat to violators of international peace. It also gives us time to enlarge our armed forces.

to the success of its military efforts. The possible obstacles mean either the military and economic strength of a single power or that of a group of potential allies. Thus, today, Russia probably possesses the superiority necessary to take Europe and the Middle East.

Berlin and Vienna are the virtual powder kegs. Expansionist moves also might be expected in the direction of Norway and Denmark or Iran. Only recently the U. S. Government announced plans to send Iran a large amount of surplus military material including 136 military aircraft.

Time with U.S.S.R.?

There are Air Force officers who contend that time is actually on the side of the U:S.S.R. because she stands an excellent chance of developing the atom bomb. A German atom scientist who said he recently "escaped" from a Russian government laboratory in Moscow, told the Associated Press that the Soviet Union is "very near" to developing an atomb bomb and that her scientists were "sweating blood" day and night to break the secret.

These officers refer to a War Department statement to Congress in April 1947 that the atom bomb "gives the offensive a marked advantage, at least for the time being, over the defensive" and "serves to emphasize the principle that only by offensive action can victory be attained."

However, the atom bomb—contrary to some public belief—is not an absolute weapon and is of limited tactical value against troops and anything other than concentrated targets. It is rather a strategic weapon.

When contemplating use of the atom bomb against Russia, the question arises as to what targets it is to be used against. Dismissing Japan as a possible base, because the Soviet probably could neutralize that country, and assuming that the Red Army overran Europe in a short time, just what target would be used? There would be no concentration of industrial or military power within practical range of our bombers, except those in the territories of our friends, until we had taken a base.

The question of using Great Britain as an atomic-warfare base, of course, already has entered military minds. However, there is the possibility that she would attempt to remain neutral or that the Soviet would serve notice on her to remain so.

Equipped with such planes as this F-80 along with other jet-propelled bombers and attack planes, the Air Force will be the vanguard of our revitalized forces.

A-Bomb May Never Be Used

This is not an attempt to dismiss the atom bomb and its tremendous power, but it can be stated that there is some high military thinking that the bomb might never be used again. Poison gas, it is pointed out, was used in World War I but not used in the last war.

Guided missiles might come in for greater use next time but this does not mean that push-button warfare is just around the corner. Rockets or other comparatively short-range missiles launched offshore from submarines or aircraft would be in general use should immediate war come.

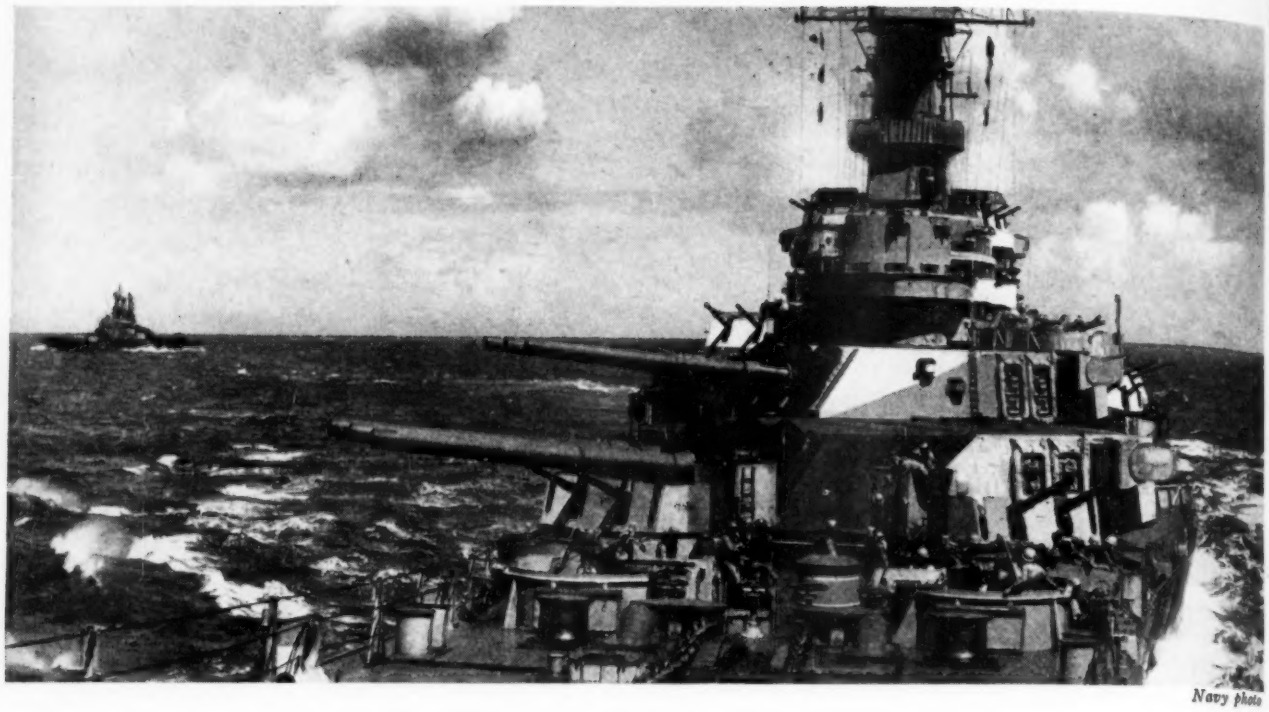
In addition to the ECA the U.S. has other time factors in its favor. Its scientific development of weapons—placed on a firmer footing during World War II—is proceeding at an accelerated pace with the greatest minds known to the world today.

American industry, though not now geared for war, is being placed on what might be termed a stand-by mobilization footing under programs developed by the Munitions Board.

Thus, month after month the balance of military power will become more and more unfavorable to the U.S.S.R.

Rockets and guided missiles would undoubtedly be in general use from the outset of any war occurring in the near future.

Mr. Giles was public relations officer of the Fourteenth Naval District at Pearl Harbor during World War II and is now a military analyst in Washington, D. C.



Navy photo

Ordnance and the Navy

Guns Will Remain Important Factors in the Atomic Age

by

Blake D. Mills, Jr.

The functions of naval vessels require conventional armament notwithstanding the implications of push-button warfare.

IN our newly opened atomic age we may tend to lose sight of such commonplace weapons as guns as important factors in our national defense. A gun cannot fire a thousand miles nor can its projectiles turn about in midair to pursue a maneuvering target, although we read in our daily papers of new superweapons intended to perform just such feats. Where, then, does the naval gun fit into the modern military picture?

A naval vessel's complement of even the finest guns falls far short of an impregnable defense even for that vessel, let alone for the ships or shore that it undertakes to defend. However, the guns still serve a vital need, and it is hardly necessary to ask the vessel's captain whether he would rather be "with 'em" or "without 'em" in time of war. Furthermore, it is not likely that every fighting ship will be fitted with atomic weapons or guided missiles or that such weapons even would be desirable in all cases. It appears, indeed, that the naval gun, developed to its highest state of perfection, will continue to be a major asset to the armament necessary for our national defense.

Until well after World War I, the principally desired attribute of a naval gun was effectiveness against surface vessels, and the design of naval guns and their ammunition reflected this purpose. Most naval projectiles were of the armor-piercing type whose thick steel walls greatly limited the explosive charge which could be carried, or of the common type with thinner walls and a somewhat larger charge of high explosive.

The velocity of shells was usually between 2,000 and 2,700 feet a second which seemed to provide a happy medium for the projectile weight, heaviness of gun construction, and the desired range of fire. That such a combination of guns and ammunition was effective for surface combat is amply evidenced by the heavy damage wrought by British and German naval forces upon each other in the memorable Battle of Jutland in World War I.

It was, of course, not a complete surprise to the world's naval commands that the proven effectiveness of guns and ammunition in World War I was to be no reliable criterion for the effectiveness of the same armament in World War II. In that conflict there were major changes in the conditions of naval warfare that had a heavy bearing on the effectiveness and design of naval armament. First, the airplane had been developed from a negligible threat in World War I to a deadly menace readily capable of sinking the mightiest naval vessel afloat. Secondly, fire control of naval guns was revolutionized by the advent of radar, a development which tended to change the time of naval engagements from day to night and extended the range of effective combat.

Mr. Mills, a commander in the Naval Reserve (Inactive), is a professor of mechanical engineering at the University of Washington.

One of the first requirements of allied naval vessels in World War II was to protect themselves and their convoys from heavy air attacks. Not so many years before this war the principal antiaircraft armament of our naval vessels consisted of caliber .50 machine guns firing solid projectiles and 3-inch hand-loaded and manually aimed guns shooting time-fuzed explosive projectiles at a none-too-rapid rate of fire. The woeful inadequacy of these guns against modern aircraft had been recognized well before the war, and some of our ships had been equipped with 5-inch, low-muzzle-velocity, antiaircraft guns which were power driven.

New 5-Inch Gun

The advent of these 5-inch guns was a major step forward, and it was to be followed by the development of a higher-velocity 5-inch gun, the now-famous "Five-inch Thirty-eight" (5-inch bore diameter or caliber, 38 calibers or 190 inches long), which was probably the most effective antiaircraft gun ever to appear in action.

Guns of this type were placed on nearly all our modern naval vessels which were large enough to carry one or more, and they were nearly entirely automatic in their operation. At first they fired only conventional projectiles, but during the war came the successful development of the amazing proximity fuze which would explode automatically upon coming within several yards of a plane. This fuze increased the antiaircraft effectiveness of the 5-inch gun several times over.

Most of the wartime feats of the 5-inch thirty-eight will doubtless go unpublished, but one of the announced accomplishments of our "Battleship X" was the destruction of 39 out of 40 torpedo bombers which simultaneously attacked the ship. However, this fine piece of ordnance can by no means be considered the ultimate in antiaircraft armament, and by this time it is doubtless almost obsolete in favor of faster-firing guns with higher muzzle velocity.

Many naval vessels are too small to carry a 5-inch gun, and it was necessary to fit these vessels with weapons which could protect them from strafing or bombing as well as to facilitate their effective attack on enemy vessels.

At the start of the war, the available and reliable caliber .50 machine gun was the obvious choice of more than one navy, and it was installed in a variety of flexible mounts that permitted quick aiming and protracted bursts of rapid fire. But the caliber .50 bullet is too small to stop an attacking plane immediately unless many hits are made, and it was considered essential to equip vessels with machine guns firing larger and explosive projectiles.

Many types of such machine guns, between 15 mm. (about 0.6-inch) and 40 mm. (about 1.6 inches) in caliber, were introduced by the various navies. Among the commonest types to see action in World War II were the 20-mm. Oerlikon and the 40-mm. Bofors. These guns, oddly enough, had their origins in countries which remained neutral throughout the war—Switzerland and Sweden, respectively.

Before the war was over, the forces of several countries, allied and Axis alike, were using guns based on and closely similar to the Oerlikon and Bofors designs. Both types of guns fired high-explosive projectiles at high rates of fire, somewhat over 400 a minute for the Oerlikon and around 120 a minute for the Bofors, at velocities of about 2,700 feet a second.

The 20-mm. was most often used in single-gun mounts, manually operated by a single gunner with the aid of ammunition handlers to keep him supplied, and this gun accounted for downing many an attacking plane which eluded the 5-inch and 40-mm. guns for a close-in attack. By the end of the war, however, the tactical effectiveness of guns as small as 20-mm. came into doubt, for although such guns shot down many planes they could not often prevent even a low-altitude bomber from completing his bomb attack before being downed.

The design of naval guns, ammunition, and fire-control equipment has come a long way in recent years.

In combating torpedo-plane attacks on major naval vessels it was found practicable to bring into play even the main battery of heavy guns which had previously been thought of as useful only against ships or shore. By firing into the water in front of a wave-skimming torpedo bomber, waterspouts could be raised which might envelop the attacking plane or at least force it to maneuver and thereby lessen the accuracy of the torpedo run.

The foregoing gives some idea of the changes in naval guns and ammunition which were brought about in order that ships might successfully protect themselves and their convoys from air attack. No less radical changes were made in the fire-control equipment which directs the aiming of the guns. The acme of fire control, of course, would be the perfection of equipment which could be sighted on an attacking plane, which would then keep itself aimed at the plane, and would keep the guns aimed at the proper point in space so that the projectiles would hit the plane.

Combat Between Ships

Having considered the antiaircraft problem, let us now turn to the usage of naval guns against surface vessels. For combat between ships, the requirements for effective guns did not change greatly between wars. To sink battleships and cruisers, projectiles must be able to penetrate the side and deck armor plate and thus must have relatively high striking velocity and great weight. In order to obtain superior striking power and range, Japan built two battleships (both of which were sunk by air attack) carrying 18-inch guns, but no other navy is known to have used guns exceeding the prewar maximum of 16-inch.

Armor-piercing projectiles are usually equipped with time-delay impact fuzes which cause the explosive charge to detonate after the projectile has passed through the armor plate into the ship.

Probably the principal development in naval guns for surface combat has been an increased rate of fire, resulting from mechanization of ammunition handling from the magazines to the guns. There has also been a trend toward abandonment of powder bag propellent charges in favor of cartridge cases in even the largest sizes of gun, facilitating faster loading, partially because less safety precautions need be taken in handling cartridge cases rather than powder bags. German 16-inch naval guns used cartridge cases in World War II, and probably the extreme in large cartridge cases was their usage in a 31.5-inch German railway gun, although powder bags were also used in that gun.

Another trend in the construction of large naval guns, and to some extent in medium-caliber guns, is the adop-

tion of the "loose liner" to facilitate the renewal of worn gun barrels. Up to about 6-inch caliber in modern naval guns it has been common to make the gun barrel from a single tube of steel. When the bore becomes so worn that the gun becomes inaccurate or its range becomes too short, the entire gun barrel must be replaced.

In most larger guns and in some smaller ones the barrel is made of several concentric tubes fitted one over the other, the innermost tube being called the "liner." In the past it was customary to assemble all the tubes on one another by "shrink fits," a method whereby an outer tube was heated to expand it slightly and the next inner tube was slid into it. Upon cooling, the outer tube shrank tightly around the inner tube. Sometimes the tubes were slightly tapered on their mating surfaces, so the liner could be pressed into place without the use of heat. In any event, the renewal of a worn gun barrel larger than about 5-inch was a major operation requiring the services of a well-equipped gun factory, where a new liner could be installed and the rifling machined with the gun assembled.

A "loose" liner is one which, as its name implies, fits loosely within the whole of the barrel, usually being fastened with a flange and bushing arrangement at the breech end. When the gun is fired, the loose liner is expanded by the gas pressure until it is reenforced by the surrounding tube. When the projectile leaves, the liner returns to its original diameter. The advantage of the loose liner is that it is relatively easy to remove and replace with a new one when it becomes worn from firing. In some cases this can be done without even removing the gun barrel from its mount. Loose liners have been used by several navies, an example being the 16-inch guns mounted on German battleships.

Ideal Naval Ordnance

Having considered several phases of modern developments in naval guns and ammunition, let us enumerate the attributes of the ideal naval gun and ammunition: (1) Short time of flight to the target; (2) high destructiveness of the projectile; (3) high rate of fire; (4) high accuracy; (5) minimum flash and smoke, and (6) minimum shipboard weight and space.

Obviously, the ideal gun cannot be a single gun. It must be a correlated variety of guns, each designed for a particular purpose but able to perform creditably for other purposes. Let us examine briefly some of the factors involved in attainment of these attributes.

Short time of flight, thereby increasing the probability of hitting a maneuvering target, has advantages that might indicate the best naval antiaircraft gun to be the one with the highest possible muzzle velocity. This indication is true to an extent, but it is greatly modified by the fact that for extremely high muzzle velocity one must accept the greater weight and size of a high-powered gun, or one must sacrifice weight (and thereby destructiveness) of the projectile or the rapidity of fire.

High muzzle velocity is sufficiently attractive to provoke a wide variety of methods for its achievement, some of which have proved practical in actual warfare and some of which remain experimental. During World War II most of the innovations in high-velocity guns were used in land warfare rather than aboard ship. Radical changes in naval guns usually lag behind those in army guns because the ship must practically be built around its armament and associated equipment. Thus major changes cannot be accomplished on short notice.

With conventional guns, the simplest ways to increase muzzle velocity are to lighten the projectile or to increase the powder pressure. The former shortens the time of flight for short range but may actually lengthen it for long range because of the greater retarding effect of air resistance on the lighter projectile. Lightweight, high-velocity projectiles shot from conventional guns were found effective for short-range land use against tanks but held no significant advantage for the longer ranges of naval warfare.

Increasing the powder pressure by using more or a faster-burning powder lowers the factors of safety of the gun barrel and projectile against rupture from excessive stress, and usually no great increase in velocity can safely be obtained in this way. To permit higher powder pressure the gun and projectile can be redesigned for greater strength, and the barrel can be made longer to let the powder gas act on the projectile for a greater distance. This trend has been followed in some navies, but it necessarily adds weight to the shipboard installation.

Problems of Design

High rate of fire, with any given degree of accuracy, improves the probability of hitting the target within a given time. When the firing ship is being attacked, time is vital. And when a plane is passing, it may not be long within range. The achievement of high rate of fire is largely a mechanical problem, involving optimum mechanization of the equipment for loading the ammunition into the gun and for ejecting the cartridge cases. But other factors are important, too. For a low-velocity gun with lightweight projectiles and small cartridge cases, the ammunition can be handled much faster than for a higher-velocity gun with more destructive projectiles, and thus a higher rate of fire can be obtained. The advantage of this higher rate would be questionable, however, and a slower-firing, more powerful gun might be preferable.

For any particular purpose, antiaircraft or otherwise, a number of factors enter into the choice of the optimum type of naval gun. Should a certain ship have a few high-powered guns or a larger number of low-powered guns? Should weight and destructiveness of projectile be sacrificed in order to obtain a higher rate of fire? These and others are problems for the tactician and the statistician, the latter of whom must rack his brain to predict the probable hitting percentages of each type of gun against each type of target.

The layman may see no problem in determining the effectiveness of each type of gun. Why not try each of them in target practice against radio-controlled ships or planes and *see* which is best? But actual effectiveness and probabilities of hitting enemy targets are not readily proved in a few target practices, and when a war is in progress ships must already be fully armed and not just waiting to compare experimental weapons.

So the matters of designing the most effective naval guns and of determining what complement of what guns should go on each ship remain problems to tax the best judgment of the naval commands of the world.

Soviet Armor

Russian Tanks Rank Among The Best in the World

by

Col. Robert J. Icks

Red designers have had years of experience in the production of track-laying vehicles

THERE has been so much discussion in the past several years about "push-button" warfare that many people have gained the impression that land warfare is a thing of the past. But man fights wars, and mechanical aids in themselves are useless without him.

It is this fact that convinces me that, in the final analysis, basic warfare always will take place on the ground. In war, man always has tried to strike an enemy without himself being struck. That, in short, was the reason for the use of armor in ancient times, and it led eventually to the development of armored fighting vehicles.

Since the beginning of the automotive age, the Russians have been conscious of this fact, and an examination of modern Russian military equipment bears out their realistic approach at the present time. In the matter of armor it is definitely apparent that Soviet Russia is not lagging behind.

Armored Steam Car

The first Russian armored vehicle was the Dwinski armored steam car built in 1900. It was found to be too heavy, and the project was dropped. But during the Russo-Japanese War the Russians became interested in the French Charron armored car, the first turreted automotive vehicle ever built. They ordered thirty-six but took delivery on only one.

In 1908, the Charron Company built two more cars for Russia, but these fell into German hands through a customs "technicality." In 1913 the Russians built their first armored car, the Russo-Balt and also purchased a turreted truck (see Fig. 1) from Armstrongs-Whitworth in England, as well as many passenger cars and trucks in France, Italy, England, and the United States.

Russian Automobile Corps

The Russian Automobile Corps was organized at the beginning of World War I, and shortly after this the Russians contracted with Austin in England to build an experimental armored car with two turrets and later ordered more. Austin, then busy with English contracts, could do no more than furnish chassis, so the armoring was done at the Putilov works in Russia.

Following this, Packard, Jeffery, Garford, Pierce-Arrow, and English Peerless trucks and French White, English Sheffield-Simplex, Italian Fiat (see Fig. 2) and German Eberhart passenger cars were armored. Extensive use was made of armored cars, even against trenches, beginning in 1916.

The poor Russian roads and the snow problem in winter led to the design of a half-track device by M. Kegresse, at that time manager of the Tsar's garage. Three hundred of these were ordered, sixty of them for Austin armored cars (see Fig. 3). A Putilov copy was designed for a Lombard truck and called the Gulkevitch armored car.

Kegresse fled to France during the Russian Revolution and became connected with Citroen, where he continued working on his half-track device. The U. S. Army Ordnance Department bought two Citroen-Kegresse vehicles and installed a conversion on a 6-ton light tank in the early 1920's. These vehicles formed the beginning of a chain of American development which led to the M3 half track in World War II, many of which were furnished to Russia under Lend-Lease.

Russian morale began to slip in 1917, and England and Belgium sent armored-car units to Russia to give concrete evidence of solidarity. These units were selected because of their mobility in order to have them take part and be seen on as many fronts as possible. English Lanchesters, Wolseleys, Rolls Royces, and Pierce-Arrows of several types and Belgian Mercedes cars operated from the Caucasus to Romania and Poland. The Russians asked for the Mark VIII tank drawings also but were denied them because of the imminent breakup. A later Russian order for Austin armored cars was taken over by the English follow-

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Fig. 1. The English-built Armstrongs-Whitworth armored car was a turreted truck, purchased in 1913 from England by Russia.

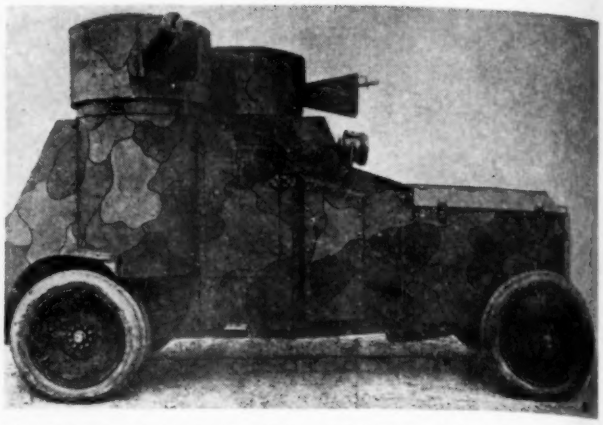

Fig. 2. In 1915, the Italian Fiat model was originally a passenger car that was armored in Russia. Other makes were also converted.

ing the great German March offensive.

Graft and incompetence were rampant in Russia, but there seemed less of it in the Automobile Corps. Brilliant use was made under trying conditions and with oddly assorted vehicles manned by personnel having inadequate mechanical training.

After the revolution, British Mark V Composite, Medium A and Medium B, French Renault and St.-Chamond tanks fell into Soviet hands. None were used in the war against Poland, but many armored car units were employed.

The Renault tanks were modified in 1923 by substituting Fiat engines and by the installation of an additional machine gun in the right side of the turret, and the following year a Renault car was modified into the Mgebrow armored car having well-shaped sloping armor. Both of these changes mark the start of independent Russian vehicle design.

An 80-ton tank supposedly was built in 1925, and in 1926 several "English Workman" (Vickers Medium Mark I), an Italian Fiat 3000 B, and a Czech KH50 tank were purchased. By 1927, the first production Russian tank, the MSI, and the first production armored car, the BA27, appeared, the latter built by AMO, the Russian Fiat licensee.

These were followed in 1928 and 1930 by the MSII and MSIII. The most significant thing about these vehicles was that while they followed somewhat the Renault tank design, interchangeability of large components, such as turret and engine, and provision for radio in the turret were apparently definite trends.

Vickers-Armstrongs sold Russia Carden Loyd Mark VI vehicles in 1929 and licensed the U.S.S.R. to build more. Similar arrangements were made regarding the Vickers Carden Loyd amphibious tank and the Vickers 6-ton tank in both twin- and single-turreted models, and the American Christie M1931 and M1933 vehicles.

Russian Proving Ground

During this period the Germans had a working arrangement with the Russians and were having their experimental vehicles tested in Russia. Among them was a Büssing 6x6 amphibious armored car which led to the design of a Russian amphibious armored car built on a Ford truck chassis.

A German engineer told me of the callous realism displayed by the Russians during the Büssing test. After completion of its field trials, the car, with its Russian test crew, was driven into a river, where it promptly sank. The Russians wrote in their notebooks, "Test failed," and got in their cars to drive away. The German engineers asked if they were not even going to save the crew and were rewarded with shrugs and the common Russian expression, "Nitchevo."

Light and medium armored cars on Ford passenger and truck chassis, again with turrets interchangeable with T26 (Vickers 6-ton type) tanks, began to appear in quantities. Bridging devices and flame throwers also were modifications applied to light-tank chassis.

The Spanish Civil War gave both Russia and the Axis powers the opportunity for field testing vehicles under combat conditions. Russian Vickers-type and Christie-type tanks and Ford armored cars were supplied to the Loyalists, their shortcomings displayed, and design improvements begun. It is of interest to note that the armored cars had no reverse gear, since the Russians believed their drivers developed more skill without it! Im-

Fig. 3. The Austin-Kegresse armored car of 1918 was one of the first half-tracked vehicles. The device was designed to cope with the Russian roads and heavy snow.

proved tanks of both types and armored cars were exported to China, Turkey, Iran, and Poland, but for Red Army use concentration began on heavier vehicles.

The war against Finland showed up many deficiencies, particularly in the heavy-tank field, and without question the Nazi nonaggression pact was signed in order to stall for time until these could be remedied. Some observers still maintain that the Finnish War was the greatest military hoax ever perpetrated in that it was deliberately engineered to allay German fears and to gain time for a war which the Russians were certain eventually would be fought with Germany. In 1940, while the pact still was in force, the KV tank was perfected but was not available in quantity.

The Russians took over considerable Polish equipment (Vickers-type light tanks and Polish TK tankettes) as well as Esthonian, Latvian, and Lithuanian vehicles (mainly Vickers-type tanks and Swedish Landsverk tanks and armored cars), on entering those countries.

Fig. 4. The KVII had a huge welded turret and mounted a 152-mm. howitzer. This particular tank had been captured by the Germans and used against the Russians.

Soviet Tanks Outmoded

When Germany attacked Russia in June 1941, the Russians were caught in an embarrassing position. The tanks produced under the great armor program in the first two Five Year Plans were outmoded. This had been apparent to Soviet designers, but only a few new vehicle designs were ready at that time, and losses were terrific. The existing maintenance organizations were dismal failures and extensive tank-recovery organizations had to be developed.

Meanwhile the BT (see p. 171) (Christie) was being replaced by the T34, the T28 heavy (see Fig. 5) was being replaced by the KV (both these were kept absolute secrets from the Germans), the T35 (two 76-mm. and two 47-mm. guns) was being replaced by the KVII, the T37 light was being replaced by the T60, and the T38 amphibious was being replaced by the T40. There was no replacement for the T26 in 1941, but the T70 light replaced these finally in the winter of 1942-1943.

The Russians had some 15,000 tanks in 1941, but the majority of these were T26's, BT's, T28's, and a few T35's.

The first German campaigns were aimed at crippling the industrial areas, which included the tank and tank-component plants at Kharkov, Mariupol, and Kirov, and the Leningrad plants were required to move within the city twice. The 1942 campaigns cost the big plants at Stalingrad and Voroshilovgrad.

In the first fifteen months the loss of the southern area carried with it the loss of sixty per cent of all the coal and metal produced in the country. The tank production facilities of the Donbas, Krivoi Rog, Dniepropetrovsk, Zaporozhe, Kharkov, Kiev, and Leningrad areas were dismantled, loaded on railway cars, and production was resumed, in some cases in the open air, in the Ural Mountains.

Although the Germans knew of the existence of plants in the Urals and in Siberia, they were unable to get at them, even by air. Plants at Stalingrad were safe except from German bombers.

The plants and plant sites in the Urals and Siberia had been built up in the fifteen years prior to the war for just such an emergency.

The first occasion that the KV tank

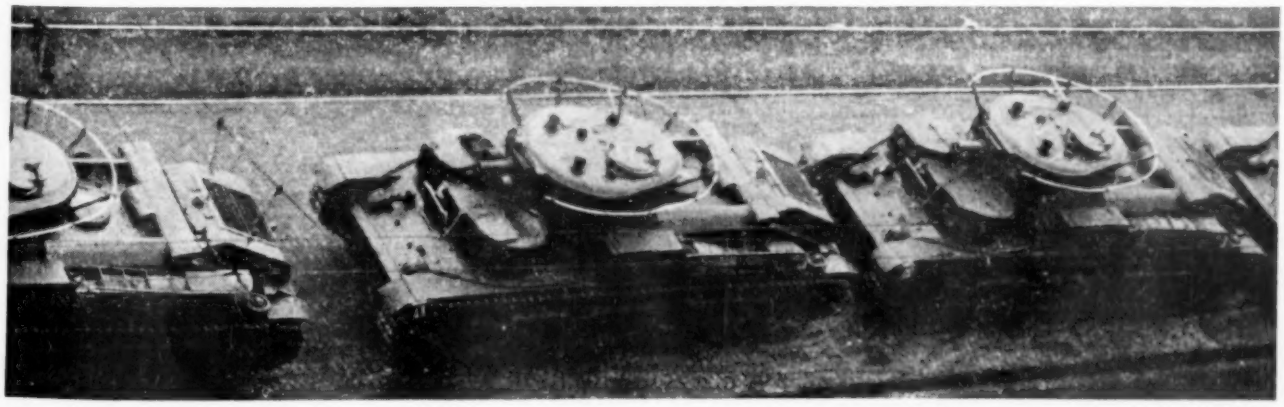

Fig. 5. The T28 heavy tank was first-line equipment at the time of the German attack in 1941. It was replaced by the KV model.

was used against the Germans was on the Moscow front in the winter of 1941. It came as a considerable surprise to the Germans. While production on this tank continued at many plants, production of the T34 began in August of that year.

Experience gained during the first year of the war was reflected in the design of the T34: speed, low silhouette, and low unit ground pressure. First employed at Stalingrad, it remained the basic medium tank for most of the war. The Germans had a very healthy respect for it and copied its silhouette in their Panther and King Tiger tanks.

Fig. 6. The Josef Stalin tanks had essentially the KV chassis with torsion-bar suspension, shallow hulls and turrets, and standardized parts for easy maintenance.

The KVIA Tank

The original KVIA weighed some fifty-two tons, was powered by a 600-horsepower V-12 Diesel engine, had a crew of five, a speed of twenty miles an hour, steel tracks, torsion-bar suspension, a 76-mm. gun and a machine gun coaxial in the welded turret, a rear turret machine gun and a bow machine gun, and 3-inch armor. Later, after antitank experience at close range, the B model had additional armor bolted to the turret and hull. The C model had a cast-armor turret with armor thicker than the A model (4 3/16 inches) and a longer 76-mm. gun. The IS model had a 107-mm. gun and a cast turret the same as that installed on the T43. The KV8 had a 4.5-cm. cannon, four machine guns, and a flame thrower. The KVII (see Fig. 4) had a huge welded turret with a 152-mm. howitzer.

The KV85 was the immediate predecessor, in 1943, to the Josef Stalin tank and had the same turret as the IS model.

The T34A had a rolled-plate turret and a short 76-mm. gun. The B was the same with a longer gun. The C had a cast turret with an overhang. The Germans found they could slip explosive charges under the overhang so the D's hexagonal cast turret eliminated the overhang in the spring of 1942. The E was the same with a turret cupola, and the F was the cast turret in its final form. Commander's tanks were the first to get the longer gun. Early in the war rubber bogie tires were used, then steel, and later rubber was reinstated.

The T50 with a 45-mm. gun was an unsuccessful replacement for the T26. The T70 was abandoned in 1944, and manufacture ceased after experience with them in battle. Many were converted to self-propelled mounts with 45-mm. Russian or 47-mm. Czech antitank guns and later with Russian 57-mm. antitank guns.

The Josef Stalin (see Fig. 6) essentially is the KV chassis, incorporating torsion-bar suspension. The front plate is a shaped casting, faired away on either side of the driver.

The first self-propelled artillery vehicles appeared simultaneously with the KV85 in the spring of 1943. Generally, standard artillery pieces are used on light tank, T34, and KV chassis. Weapons used during the war were 76-mm., 85-mm., 122-mm. guns and the 152-mm. and 203-mm. howitzers.

During World War II the United States furnished Russia under Lend-Lease M3 medium tanks and M3 light tanks, as well as M3 scout cars and half-tracks, and later M4A2 (Diesel) tanks. Production demands fluctuated constantly as Russians captured German tanks and rehabilitated them for their own use, or as the tide of battle ebbed and flowed.

They Can "Take It"

Russian tanks appear to be able to "take it." They must if that is a sample of their treatment of vehicles and components! One of the interesting things to me about the Russian tanks I have seen is the finish. Armor plates looked as though they were hacked off and welded together. Exterior finish of castings, gun tubes, etc., was rough. Only mating surfaces, interiors of gun tubes, optical instruments, and similar items were highly finished.

In asking a Russian about this he replied, "Why do you waste time finishing the surfaces of your tanks like they were passenger automobiles? What a waste of man-hours. In the first place, we don't have the skilled help to waste as you seem to have. In the second place, to us a tank is built to last for only three shots. One you get off and may miss, the second the enemy gets off and may miss, and the third either one of you hits. It had better be you that hits him because he isn't going to miss the next time." I think he had something!

To continue, the English also furnished the Russians with armored equipment during the war—Covenanter Mark V Cruisers, Mark II Matilda tanks, and Mark VII Tetrarch airborne tanks and some armored cars—while the Canadians furnished Mark VI and VII Valentine tanks to Russia during the conflict.

The basic policy of Red tank designers appears not merely to seek to match the best elsewhere but rather to anticipate such developments and to keep the U.S.S.R. one step ahead of any one else. Shaped armor castings have been developed to a high degree. The Germans said that these castings were responsible for a forty per cent reduction in penetrating hits.

With their background of technical and production experience in war and peace; captured, purchased, and Lend-Lease vehicles; their espionage service; and the captured and conscripted German technicians available to them, their designs are bound to reflect their policy of keeping ahead of competition.

Russian artillery and its handling has always been good and admittedly among the best in the world. It is time we admit that their tanks are top-flight as well.

Defense Is Men

The Military Could Learn Management of Man Power from American Industry

by

Robert Wood Johnson

COMBAT machines, ships, planes, scientific instruments, and better weapons than those of the enemy are essential tools of war. What we sometimes forget is that every one of these tools is the result of applied brains and brawn.

The Air Corps, the Navy, and the Army are, above all else, organizations of persons, not airplanes, ships, and tanks. Lately we have badly twisted our sights in the process of raising them. There is a school of thought that believes defense is essentially the procurement of planes, submarines, and other scientific weapons. Another school insists that the answer is man power. The latter school, however, thinks in terms of numbers rather than in terms of quality or, when the quality of man power is discussed, too frequently dwells exclusively on the physical attributes of the volunteer or conscript.

Both these views ignore the mental attitude of the soldier, sailor, noncom, and officer and their ability to work with others as enthusiastic parts of an effective team. They erroneously take for granted that, given modern weapons and men in quantity, good management will automatically come into being.

Here in the United States the public recognizes that the key to success in the various fields of activity is good management—be it the corner grocery store, the university, the factory, or any place where men and women join together to perform an essential service. Our country has given a generation of specialized thought to the question of modern management, but when it comes to the defense of our Nation, it seems to have learned very little.

We must have an entirely new concept of military management. This concept must start at the top and work into the lowest ranks and, by the same token, must also begin at the bottom and work up to the Commander in Chief. Modern management is a 2-way street with constant and enlightened information passing both ways at all times.

Can we produce good military management under the banner of the individual conscript? In emergencies and crises it is granted that emergency methods have a place. But right now we are trying to develop both a short-term and a long-term defense. Have we really thought this through? We might as well admit that we face twenty-five years of preparedness—perhaps more. This demands a highly skilled, well-directed force in the air, on the land, and on the sea, ready for instantaneous action twenty-four hours every day—Saturdays and Sundays included (remember Pearl Harbor?).

We are a long way from the days of the squirrel-gun huntsman wearing a raccoon hat. He could become an almost completely independent fighting unit. He fed himself from forest game. He was his own commissary and largely his own quartermaster corps. He was a crack shot; he also was in top physical condition. He could be recruited overnight and be effective in the combat of that day.

Intensive Training Required

But now all this has changed. Our technician of today cannot be recruited overnight, and he cannot be developed into a useful combat man without months and usually years of intense training followed by years of refresher training and constant modernization. To develop such fighting men we must apply principles and methods that have proved themselves in American business.

The first of these, the very foundation, is that each human being must possess and develop dignity. No really informed, coöperative *esprit de corps* can come from compulsion. Discipline is necessary, of course, especially for the negligible recalcitrant minority. Our military organization cannot be a debating society, but it does not have to be a prison camp.

Well-managed organizations in and out of business have come to see that men work best when encouraged through proper executive environment. The expression of this new policy, so necessary to the technological military organizations of the present and future, will take many forms. First, there is

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the already-recognized need for the more complete merger of the services. Secondly, there is the diminishing influence of what is called the "trade school"—to be more specific, the class-conscious graduates of Annapolis and West Point. (These schools might become postgraduate colleges for all ranks in all services.)

There is much to be said in favor of our official military schools. The officers who were most criticized by the GI's were those who had had little training. Although Reserve officers usually are critical of the Regulars, the men in the ranks frequently are less critical. Some say that the record speaks for itself; namely, that we have won two major wars under the leadership of top field commanders from West Point and Annapolis.

That is true, but it fails to recognize a further truth—that these wars were won primarily by the productive resources of the United States and the youngsters in uniform. True, credit does belong to our military leadership but certainly not exclusive credit.

Annapolis and West Point have many highly emotional champions. I remind them that the United States Marines are unusually effective in combat and otherwise. Generally speaking, the Marine Corps has been built to its present point of effectiveness outside the Academies. Moreover, officers from military institutes and universities often make unrivaled records. Virginia Military Institute, The Citadel, the University of Oklahoma, the University of Minnesota, and other fine schools have contributed greatly to our superlative fighting force.

True, there are some class rings in the Marine Corps—a few from West Point and several from Annapolis. Most of these officers are excellent, but they also are self-selected. By that I mean a certain and unusually capable type of Regular officer chooses to join the Marine Corps.

Thirdly, the elimination of the outward insignia of rank should be considered, except in a simplified form wherein commissioned officers, from second lieutenant to admiral and general, would wear one star and noncommissioned personnel, a star of different color. These men would, of course, have their present rank and authority, but their titles would not be emblazoned on their lapels or shoulder straps.

The whole approach would be based on the theory that military service would be made attractive, not only from the standpoint of pay and such material aspects as better living quarters and a greater opportunity for further education, but also for self-expression, advancement, and the pursuit of happiness in one's job.

New Training Concepts

We should visualize a new type of training based on the theory that every military officer should understand the workings of industry, and that many industrial executives should be well informed on military matters. To achieve this, the military officer might well spend a considerable portion of his time in business and industrial operations as an actual worker, operator, and executive. The business executive, on the other hand, would accept assignments in the military organizations covering an extended period wherein he would be assigned actual executive responsibilities.

"We are a long way from the days of the squirrel-gun huntsman . . . an almost completely independent fighting unit."

In neither case would the exchange merely amount to observation and study. Rather the individual would enter into the executive structure of the service or a business to which he was assigned. This arrangement would be carried out at all levels and in all ranks. It would apply to the lieutenant and ensign, as well as to the 4-star admiral and general. Coupled with this partnership would be training in the field of human relations based essentially upon the best practices of civilian commerce and industry.

Patriotic love of country will, of course, play an important part. The prestige of belonging to a great service will influence many. These influences are good for both man and country. A life devoted to the cause of freedom is an inspiration, especially to those who are treated as free men rather than as conscripts.

A prominent member of Congress wrote to me recently saying that he was opposed to a financial incentive for men entering the services as he felt that such a plan indicated that we had come to a pretty pass when men would only serve their country because of pay. To correct this my friend wants conscription.

Such a conclusion is illogical, and perhaps the best way to clear it up is to admit that in one sense we have come to a "pretty pass." We can assure our friend in Congress that men will serve for love of country, and that there is at least as much patriotism today, and probably more, than at any time since the Revolutionary War. This patriotism, however, is partially dormant except in times of emergency. One could go on to say that even in war a service built on the concept of the dignity of the individual would be a better service than one built on compulsion. The truth is as simple as this: We must attract our good men if we expect them to choose a military career. The alternative is the sullen mediocrity of unwilling conscripts.

In the recent bitter years of management-labor strife, we have learned the hard way. So far these lessons and the answers we have found have not been conveyed to the military phase of our national life. Now that we are determined to have a strong defense, it would seem only logical that the time has come to recast our military management. We want our best people to defend us effectively and economically.

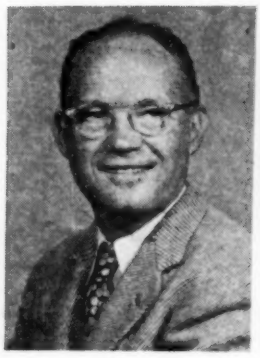
Defense Is Men

Yes, defense is men—masses of men, not men *en masse*. To win wars, these men must be free men. Given good weapons, victory will depend more on the principle of freedom and good management than on any other factor. We can never forget that the next war will be fought in our own back yard as well as on the intermediate and distant fronts. We must translate total war and total defense into an operative technique that not only defends freedom but develops it.

It is hard for some of us to believe that we may have to fight for our freedom all over again, but that is the meaning of world events. It is harder still to realize that much of the fight must take place here at home, against persons who unwisely recommend that our Government put chains on us. Incentive takes many forms and patterns: patriotism; the will to serve; self-expression; fair, honest, intelligent management; good pay; and pride. These cannot be developed through force.

For Eminent Service We Salute These Industry-Ordnance Leaders

H. L. Clark



Col. G. B. Jarrett

Lieut. Gen. B. W. Chidlaw

Capt. J. M. Worthington

Rear Adm. F. G. Fahrion

Henry L. Clark is president of the Los Angeles Post, American Ordnance Association, and manager of the Southern California Plant, Buick-Oldsmobile-Pontiac Assembly Division of General Motors. He has filled many important assignments with GMC. During World War II he participated in the building of tanks and aircraft.

Col. G. Burling Jarrett, Aberdeen Proving Ground, Md., is chief of the Library and Museum Branch at the proving ground. He served with distinction throughout World War II as an officer of the Ordnance Department and developed technical intelligence for Ordnance while in Egypt in 1941. A member of the American Ordnance Association since 1926, he is a world-wide authority on ordnance.

Lieut. Gen. B. W. Chidlaw, Wright Field, Ohio, is Deputy Commanding General, Air Matériel Command, United States Air Force. He has had a long and successful career as an officer of the Air Force in combat and in technical assignments having to do with notable advances in aircraft design.

Capt. J. M. Worthington, Washington, D. C., is deputy commandant for Education, Industrial College of the Armed Forces. A graduate of the United States Naval Academy and Postgraduate School, Army Industrial College, and Naval War College, he has taken an important part in the advancement of military and industrial education within the armed services.

Rear Adm. F. G. Fahrion, is Superintendent, United States Naval Gun Factory, Washington, D. C. He was commander of all naval task groups involved in "Operation Crossroads" at Bikini where he was actively engaged in the atomic-bomb tests.

Col. S. E. Hammersley, Waterford, N. Y., recently concluded an outstanding career as ordnance engineer at the Watervliet Arsenal, N. Y. During World War II he was actively in charge of an important phase of heavy gun production which won him the esteem of all members of the Ordnance fraternity.

E. C. Hadley, Bridgeport, Conn., is chairman of the Small Arms Ammunition Committee of the American Ordnance Association. For more than twenty years he has served as chairman of the Technical Committee of the Sporting Arms and Ammunition Manufacturers' Institute. He is director of manufacture of the Remington Arms Company, Inc.

Col. W. T. Hudnell, commanding officer, 56th Fighter Wing, Selfridge Air Force Base, Mich., directed the historic Selfridge program incident to the Thirtieth National Meeting of the American Ordnance Association last June. He served with the Fifth Air Force in the Pacific during World War II and was Deputy Chief of Staff on Gen. George C. Kenney's Far East Air Force.

Col. René R. Studler has a world-wide reputation as an expert in the development of small arms. He is chief of the Small Arms Development Branch of Army Ordnance Research and Development Division. He was the only Ordnance military attaché in Europe from 1935 to 1940 observing and recording the armament of the European nations for World War II.

Ferdinand Schmitz, Jr., is executive vice-president of Pacific Car and Foundry Company, Renton, Wash. He took an active part in that company's program for the production of ordnance in World War II. He is president of the Puget Sound Post, A.O.A.

Col. S. E. Hammersley

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Col. W. T. Hudnell

Col. R. R. Studler

Ferdinand Schmitz, Jr.

One Army

The Essence of the Gray Board Report on Civilian Components

Lieut. Col. H. N. Willoughby

Do we have the selflessness and courage to face our military problems realistically?

THE title of the Gray Board report might well have been, "A Challenge and a Guide to National Security." Courage, integrity, and vision distinguish the members of the Board for their profound study released to the public on August 10, 1948.

The report is in, but to date—less than a month before election in this campaign year—nothing has been done about it. When the Board, in its introduction to the report, states that "considerations of partisan or political expedience have no place in an objective study of a matter fraught with grave consequences for the Nation," it correctly anticipated that personal selfishness and political expedience would bring howls and incriminating charges from certain factions throughout the country.

Unfortunately, only a small minority of the public has had an opportunity to understand the true facts this report reveals since, generally, the press and news services only superficially cover great public documents while featuring incidents of momentary interest, these being less technical, more easily assembled, and more colorful. The report embodies the unanimous conclusions, after nine months of study, of the six members of the Board—the three Assistant Secretaries (Army, Navy, Air) and one ranking officer from each of the three services. The limits of this article preclude detailed discussion of the Board's ninety recommendations. I shall limit my observations to the Board's first and basic recommendation; namely, "National security requires that all services (Army, Navy, and Air) each have one Federal Reserve force." This recommendation is the essence of the report because basic organization, whether military or industrial, is fundamental and paramount to all other factors, excepting the selection of operating personnel.

Before we go into the opposition's arguments (the same arguments incidentally which have been used for years to thwart correction of these weaknesses in our military organization), let us consider the changes recommended by the Board in the Army Reserve structure, a far more outmoded one than that of the Navy in relation to its primary missions. Thus, we are concerned here with the Army Reserve situation.

Revisions Recommended

The Board's recommended organizational revisions in the Army were briefly these:

1. That the National Guard be federalized and its personnel, facilities, and equipment—jointly with those of the Organized Reserve Corps—be welded into a single National Reserve Force under Federal control to support and augment the Regular Army establishment.

2. That a combination (State and Federal) internal security force be established, composed of personnel not subject to or eligible for combat duty (overage and limited-service personnel); and that civilian defense "is and should be a civilian function."

Thus the crux of this entire matter rests with and depends upon whether we as a Nation decide upon maintaining a costly and inefficient tradition or have the vision and courage to face world conditions realistically by establishing a *single National Reserve Force* in the Army.

We depend on the Army for its share in our security. Yet in our present multiple Reserve organization we deny our Chief of Staff the authority to plan for and carry out the provisions necessary to ensure our security. We in industry would consider a board of directors stupid if they designated a general manager, charged him with over-all responsibilities of a company—and at the same time denied him the authority and administrative control of a large and important segment of the company's property and personnel.

Our Chief of Staff is placed in this identical situation. Under the present structure our Army is composed of the Regular Establishment (under Federal control), the National Guard (controlled by the adjutant generals of the several States—politicians all), and the Organized Reserve Corps (under Federal control). Thus it is proper to ask why a nation, leading all others in industrial organization and management, should condone and acquiesce in the continuance of the dangerous and costly inefficiencies that exist in many phases of our military and governmental affairs.

Every citizen has a share in and a responsibility for these continuing weaknesses whether or not we conscientiously acknowledge them or indicate a virile interest in their correction. If we further sanction these inefficiencies, we must be satisfied with our "dividends" as apathetic citizens.

Now to consider the more prevalent arguments resorted to by opponents of the Gray Board's recommendations, which fall into two general themes: (1) The Guard is an old tradition and belongs to the States and local communities, and (2) The proposal is unconstitutional and infringes on States' rights.

It will readily be seen that these arguments are related to and stem from the same group interests. In the main they carry a similar tone, whether the statements emanate from the National Guard Association, the Adjutant Generals' Association, Governors of various States, or local political interests.

In appraising these arguments we should remember that the adjutant general who commands the National Guard organization within his State is an

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Colonel Willoughby, a Reserve Ordnance officer, was formerly president of the Indiana Department and National Executive Committeeman of the Reserve Officers' Association.

important political appointee of the Governor but not necessarily an experienced soldier. State political appointees usually have a speaking acquaintance with the State's members of the national Congress. Thus, we have a hierarchy that understandably has a high interest in retaining control of any segment of a State's organization.

In so grave a matter as national security, the injection of States' rights is a cheap demagogic political act which deserves only our contempt. Today we are smothered with the concern of self-appointed guardians who constantly harangue us about individual rights, group interests, States' rights, etc. But we hear relatively little about our obligations, responsibilities, and the fundamental tenets of a democracy. A citizen has too few examples of selfless national interest and integrity to guide or keep him alert to his citizenship.

To the overworked argument that tradition must be maintained, let me confess that occasionally during the past two years I have been inclined to believe it might be important. However, our present social *mores* lead me to question the proportion of our population that is impressed by tradition. We might ask: "Do we want tradition or national security?" The Board's report has surely proved that our present military organization is inefficient. Is a tradition of inefficiency worth maintaining?

Not Unconstitutional

To brand as unconstitutional the Board's recommendation to combine the National Guard and the Organized Reserve Corps, as some have done (admittedly before reading the report), is to make a statement contrary to fact. Those who cry, "Unconstitutional!" point to that part of the Constitution which gives the several States the right to raise and maintain a military force to keep internal order.

The Board's recommendation does not deny that right. Many States already have such forces organized and devoted to the mission of maintaining internal order. But no State needs armored divisions, antiaircraft artillery, or combat aviation to keep order in a conceivable emergency such as fire or flood.

The National Guard requirements at present are beyond the internal requirements of any State, both in number and in types of units. A few military-police battalions, in coöperation with an adequate State police force —backed up by transport, supply, and administrative units—can easily take care of any internal situation within a State. Many governors have already seen this truth and expressed their willingness to turn over their National Guard units to the Federal Government, thus relieving the State of a heavy financial burden for which it gets no commensurate return.

But our military "labor bosses"—the officials of the National Guard Association and the Adjutant Generals' Association, whose positions depend on the State control of the National Guard —take no such logical views. They are the ones who maintain the sophistry that the Board's primary recommendation is unconstitutional and infringes on States' rights.

These are the principal arguments which you may expect. There are others, which also fail to bear up under a reasonable inspection based on logic. Unfortunately, basic principles, like ideals, are speechless and, too, society rarely organizes itself in positive promotion of great principles, whereas pressure groups, being well organized, find easy voice for their objectives and critical obstruction.

It is fervently hoped that every one will study the report with detailed care and estimate its worth on the basis of his own organizational experience. Principles of sound organization apply universally whether in industry or the military. Let no one be confused on this.

Think through these organized criticisms of the purposes the Board has sought to accomplish. If you follow these suggestions and accept the simple fact that the average and great majority of our citizens (including Guardsmen, Reservists, and military Regulars) seek only the opportunity to provide a home, education, reasonable recreation, and security for their families, then I believe you will find agreement with my considered opinion, based on personal experience and in discussing the subject with hundreds of citizens, Reservists, Guardsmen, and military Regulars.

These are some of the factors that unfortunately becloud the proposals of the Gray Board. They are related here in order to serve in appraising the logic of the Board's conclusions. The issue is controversial for obvious reasons. It is a careful statement of fact to say—with conviction—that if we fail to heed the Board's recommendations and continue our present obsolete Army Reserve structure we condone political expediency and individual selfishness in high places rather than respect logic.

The Secretary of Defense demonstrated his awareness and keen understanding of the greatest single weakness in our Military Establishment when he appointed the Gray Board last November. He also indicated his appreciation of the importance of a sound solution by his selection of the members—an equal number from each service and men of great experience in their respective services.

Now it is to be hoped that the Secretary will demonstrate an equal degree of forceful interest in urging implementation of the Board's basic recommendation. Likewise it is further hoped that the President and the Congress will demonstrate their share of responsibility with a complete disregard of political allegiances in this instance and recognize the urgency of this vital defense measure.

Efforts May Become Futile

The great purposes to which the American Ordnance Association is dedicated and its members' personal contributions to them—industrial preparedness, research, and scientific progress—in a degree become wasted and futile efforts if, meantime, we permit our Army—the user of these improvements—to be handicapped by an antiquated Reserve and National Guard structure. To sanction the continuance of an outmoded system in command and administration while desperately striving to improve our scientific and industrial plant is certainly an inconsistency.

Until the Gray Board's recommendations are implemented into law, it remains only a commendable report. If we let political expediency and personal selfishness, safeguarded by public apathy and lack of understanding, deny us this long-overdue revision in our Army Reserve structure, then the tragic weaknesses the report proposes to correct will remain a part of our defense structure. *Shall we accept the challenge?*

Early Pyrotechnics—Part II

Evolution of the Gun

Missing Links Found in Projectile Weapons' Ancestry

by
Tenney L. Davis

Did our modern weapons originate in the fire-spouting devices of the ancient Chinese?

A PALEONTOLOGIST confronted with a miscellaneous collection of fossils is able to sort them into groups or classes and within the classes to arrange them in the order of their complexity in such manner that a continuous and gradual development is apparent. The conclusion that this order represents the process of their evolution becomes well-nigh inescapable.

The "Wu pei chih" ("Treatise on Military Equipment") of Mao Yüan-i, written about 1621, presents for our study just such a varied collection of "fossil" fire weapons. Selected portions of it have been translated recently by Prof. James R. Ware and discussed by Davis and Ware in the *Journal of Chemical Education*, 24, 522-537 (1947). It is abundantly illustrated by pictures which are unequivocal and often more revealing than the text itself.

Among its many pyrotechnic devices certain ones furnish a seemingly complete picture of the steps in the evolution of the gun from spouting fire weapons—illustrating all the possibilities from Roman candles to match-fired guns with separate-loading ammunition. The fact that the various contrivances are not dated affects in no way the validity of the conclusion.

The question about Greek fire which has been most puzzling to historians has been not so much what it was composed of as how it worked. Some have thought that it was used in rockets; others that it was a liquid incendiary squirted by means of a pump. But the most probable conclusion from the evidence appears to be that it operated in the manner of a Roman candle, burning in a tube and ejecting masses of incendiary material from time to time to a considerable distance. The obvious continuity of the series from Roman candle to modern gun gives additional probability to the belief that Greek fire did indeed operate in this way.

And the discovery of heretofore unknown "missing links" between the automatically repeating, incendiary-throwing Roman candle and the single-shot gun which throws an inert projectile gives great plausibility to the belief that guns arose by an evolutionary process from the liquid or Romaic fire of the Byzantines.

Greek fire, introduced by the engineer Kallinikos of Heliopolis in Syria, supplied the principal basis of Byzantine naval and military strategy for more than seven centuries, from about 670 A.D. until the fall of Constantinople in 1453. Its composition was a closely guarded "divine secret," but its performance as reported by the annalists and chroniclers indicates that it contained saltpeter.

It was used in four ways: (1) in *siphons*, or large copper tubes fixed in the prows of the ships, from which masses of burning material were ejected; (2) in *strepta*, or smaller, permanently mounted, maneuverable tubes from which the fire could be aimed in various directions; (3) in *cheirosiphons* or portable hand tubes of spouting fire; and (4) in fire pots or incendiary grenades.

The name "liquid fire" perhaps refers to the composition being prepared and loaded while plastic from heat but, more likely, to the manner in which the fire could be poured out.

The first three of the above-mentioned devices were probably precursors of our modern Roman candles. There is also considerable likelihood that the *cheirosiphons* were used in two ways: As jet-propulsion devices, forerunners of rockets, they could be pointed in the desired direction, fire end toward the operator, and then released from the hand; as fire-spouters they would require to be grasped firmly, fire end away from the operator. The "Wu pei chih" describes and illustrates fire-spouters which may perhaps be identical with the Byzantine *cheirosiphons*.

The historian, Anna Comnena, daughter of Alexis (Emperor of Byzantium, 1081-1118) described how her father made good use of Greek fire against the Pisans.

"Knowing that the Pisans were skilled in naval warfare and fearing the issue of battle, [the Emperor] placed in front, on the prows of each of the ships, snarling copper and iron heads of lions and of other wild animals and had them gilded to make their appearance still more fearful; then he ordered the fire to be prepared which,

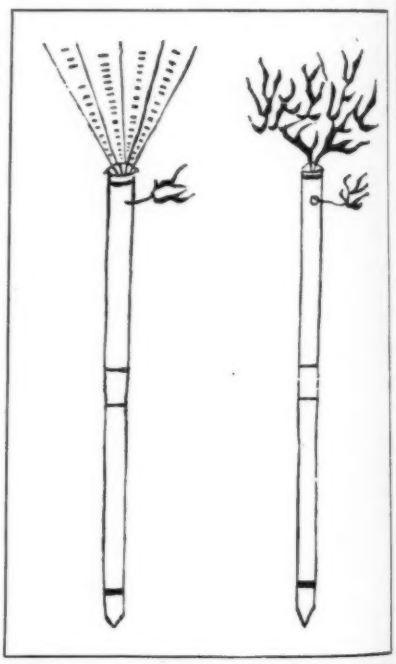

Fig. 1. The "upset-horse fire-serpent divine staff," of wrought iron, was loaded with spattering fire and lead bullets.

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Fig. 2. This prototype of the modern gun fired 20 shots without reloading.

by means of *strepta,* should be launched against the enemy through their mouths so that it should appear that the lions and other wild animals vomited it . . . The barbarians were frightened by the shooting fire to which they were not accustomed and which, though its nature was to rise in the air, came down again, sometimes below, sometimes from the side, wherever the person wished who was directing it."

The same author also tells how the inhabitants of Durazzo, when their city was besieged by Boemond in 1106, used Greek fire against the Normans in a fight in a subterranean passage. Her description of the composition and of its use is clear enough if we understand that saltpeter (which she does not mention) was one of the ingredients.

"To make the fire for certain ingenious contrivances, the dried gum (rosin) from firs and from other evergreen trees is collected and is ground up with sulphur, and the mixture is packed in the hollow stems of rushes into which it is introduced by a strong and continued puff of the breath like a flute-player's note. Then it is lighted by applying fire to one end, and, like a burning meteor, it falls on whatever objects are opposed to it. The inhabitants of Durazzo, by using this fire in hand-to-hand fighting, burned the beards and faces of the enemy."

From these descriptions we are able to recognize the same or related devices when we find them described in the "Wu pei chih" and from the later descriptions to work backward toward a surer, clearer conception of Greek fire.

The first *siphon* was perhaps a tube into which a warm and plastic mixture of saltpeter with sulphur, rosin, bitumen, etc., had been stuffed. The charge burned unevenly, the flame darting behind the denser portions where it built up pressures, intermittently ejecting blazing masses with a coughing action. In the course of time improvements were made—one composition was found to be more suitable for the incendiary projectile, another for producing the gas which propelled it. Black powder was developed for the latter purpose, suitable for use in fireworks before guns were invented.

The "Wu pei chih" describes a fire weapon which was loaded like a Roman candle and threw incendiary pellets which burned with a bright light and a toxic smoke. The text tells how it was loaded: first a layer of slow powder containing relatively much charcoal and relatively little saltpeter, then a layer of "spurting powder," then one pellet, of a size adapted to the tube, containing saltpeter, camphor, pine perfume, realgar, and white arsenic, then the same sequence again until five such loadings had been made. It states that the pellets traveled several hundred feet.

The use of bullets in this device instead of incendiary pellets converted it into an automatic repeating gun. And the separating of the charges behind the several bullets, so that fire would not travel from one to the next, deprived the instrument of its automatic action and made it possible to shoot it repeatedly at will.

The "upset-horse fire-serpent divine staff," pictured in Figure 1, consisted of a tube of wrought iron, three feet long, loaded with spattering fire and lead bullets, supported by a wooden handle four feet in length.

Two repeating guns, each with several rounds loaded in the same barrel, are shown in Figures 2 and 3.

The first of these was made of

Fig. 3. A 3-shot matchlock shoulder gun with separate-loading ammunition.

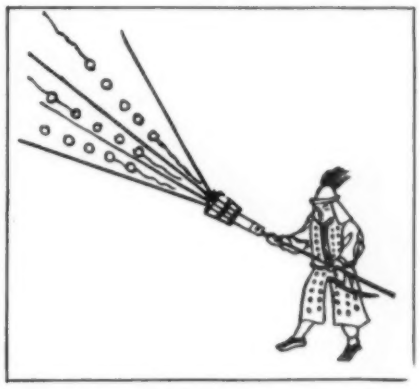


Fig. 4. A multiple-shot "gun" with one large iron barrel and ten smaller ones.

wrought iron, weighed fifteen pounds, and was five feet long. The middle portion was solid for one foot, and the two ends consisted of hollow bands each supplied with its own powder charge and match, paper wadding, and bullet weighing 0.15-ounce. Ten shots could be fired from each end.

The second device, a shoulder gun, was made of wrought iron 1.2 feet long and 0.22 of a foot in diameter. A wooden staff-handle was attached 0.3 of a foot behind the forward end. The barrel accommodated 3 cartridges, each 0.3 of a foot long and 0.17 of a foot in diameter, and was slotted along the top for the fuses. Each cartridge contained 0.8 of an ounce of powder.

It seems probable that these devices did not always operate smoothly but that accidents were caused by the fire of the first charge communicating itself to the other charges. Such mishaps could be avoided by loading each charge in a separate barrel, and it is likely that guns evolved in this way.

A particularly interesting specimen is shown in Figure 4, a multiple-shot gun with one large barrel of wrought iron and ten smaller ones, each 1.5 feet long and each loaded with "several tens" of shot.

The "Wu pei chih" contains pictures of guns and cannon of Asiatic origin such as the Chinese are known to have used in 1356 and probably as early as 1236. It also contains pictures and a description of the "fo-lang-chi," calivers or swivel guns with removable breech, which the Portuguese navigators had on shipboard when they visited Canton in 1517. It is indeed a rich museum of antiquities for the student of the history of fire weapons.

(Dr. Davis will continue his discussion of early pyrotechnics in subsequent issues.—THE EDITORS.)

Protection from Atomic Radiation

Overcoming Hazards Requires Specially Trained Men

by
Dr. Karl Z. Morgan

A new field of industrial hygiene has been created with the increasing use and development of radioactive material

WHEN one speaks of atomic machines he usually thinks of developments in the field of atomic energy since its beginnings at the University of Chicago on December 2, 1942. It was on this day that the first man-made atomic machine was operated.

However, this was not the first atomic machine: the sun and all the stars are centers of enormous atomic activity which maintain incandescence from heat generated by nuclear reactions and at the expense of mass converted into energy in accordance with a law of physics first suggested by Einstein. This law may be stated as follows: Energy in ergs = 9×10^{20} x mass in grams.

F. W. Aston showed in 1927 that if the nuclei of the lighter elements like hydrogen and helium could be converted into elements of intermediate mass like carbon, sodium, chlorine, calcium, and down to krypton, enormous energy would be given off. Some of these lighter element reactions are believed to account for the enormous energy of the sun and the stars, and the annihilation of several of the nuclear particles in the remote reaches of space probably results in the production of cosmic rays.

Fortunately for man, the sun is about ninety-three million miles away and the nearest stars are several light years distant. Thus a very small fraction of the lethal atomic radiations from outer space are intercepted by our earth, and the earth's magnetic field deflects the ionizing part of this radiation. All the remaining radiations that are directed toward the earth are diminished by the blanket of air that surrounds it.

Aston also indicated that if the heavier elements, beginning with uranium, would break down into lighter elements, energy would be given off all the way down to krypton. It had been already observed by Becquerel in 1896 that uranium was spontaneously breaking down. By the emission of helium nuclei (called alpha particles) and electrons (called beta particles), uranium was converted into a series of lighter elements and finally into a lead residue.

New Chain Reactions

Two other natural chain reactions, one called the thorium chain and the other the actinium chain, were discovered, and all these seemed to terminate with the formation of lead.

The spontaneous decay of lead has never been observed, but if it does go through a natural nuclear decay, it is at such a slow rate that it probably cannot be observed.

One of the natural chains of radioactive elements was listed as missing during the past two decades because no part of it could be found experimentally even though its existence was suspected from a theoretical point of view.

This "missing chain" was finally discovered as one of the products of uranium fission. It had not been discovered in nature before because the parent element of this chain, neptunium, has a half life (time for half of an element to decay to the next element down the chain) of only a little over two million years. All neptunium and the daughter elements that have even shorter half lives have disappeared long

Dr. Karl Z. Morgan is director of the Health Physics Division of the Oak Ridge National Laboratory at Oak Ridge, Tenn. He has been engaged in the study and the solution of radiation protection problems on the atomic-energy projects since the spring of 1943. Before that time he was head of the physics department of Lenoir Rhyne College where he conducted cosmic-ray research in coöperation with Duke University.

ago from our earth which is known to have been solidified at least two billion years ago.

All four of the parents of these chains of natural radioactive elements have grandparents. For example, plutonium is the grandparent in the so-called actinium chain, but it has long since disappeared in nature since it has a half life of only twenty-four thousand years.

This latter statement is not wholly true, however, since submicroscopic quantities are constantly being produced in the fission caused by the bombardment of the uranium in the earth's surface by cosmic-ray neutrons. Of course, many cosmic-ray neutrons are being captured by the elements in the earth. One of the most important of these reactions leads to the production of carbon-14 from ordinary nitrogen.

Man Has Survived

Thus man has been exposed to all these natural radiations since the beginning of his existence. This radiation has probably not done man any good, but, if it is harmful, man has survived and developed in spite of it. Natural radiation amounts to about 0.01 milliroentgens an hour, or about one four hundredth of the tolerance rate of radiation. This tolerance rate is taken as 4.17 milliroentgens an hour, or 100 mr a day.

When atomic-energy projects began, one of the first problems was to decide what the tolerance rate should be. The generally accepted value in Europe was 200 mr a day and the American Advisory Committee for X-ray and Radium Protection had set 100 mr a day.

The latter value was chosen which is fortunate because since then information has been accumulated to indicate that this 100 mr per day should be considered as a maximum permissible dose. It is believed by many that certain undesirable biological and genetic effects will result if one is subjected to this level of radiation for twenty or thirty years.

Since 1895, when Roentgen discovered X-rays, man has added this new source of radiation exposure to the others. The use of radium and X-rays has been of great benefit to man. But due to ignorance or carelessness in their use, many men have suffered and died.

When atomic-energy projects began, it was recognized that a single atomic-energy pile or a single atomic bomb would produce millions of times as much radiation as all the radium available to man in the world.

It was with this thought in mind that the first health-physics department was organized at the Metallurgical Laboratory of the University of Chicago, and when operations began at Oak Ridge, Tenn., and at Hanford, Wash., health-physics divisions were organized there.

The purpose of health-physics has been to make a study of radiation and to develop means by which radiation exposure may be kept at a minimum. At present, there are about 400 health physicists all together at these three sites. These men have been recruited from among physicists, chemists, and engineers. Many technicians are employed for routine operations in health physics, and chemical engineers and junior physicists are trained for radiation survey assignments. Physics is the principal foundation course in the training of a health physicist; therefore the senior men are physicists.

The health-physics divisions are divided into three sections: (1) research and development; (2) personnel monitoring; and (3) radiation survey. The research and development section has attempted to develop new radiation-detection instruments before, rather than after, they are seriously needed. It makes many calculations on shielding requirements, tolerance doses of radioisotopes, radiation scattering, etc.

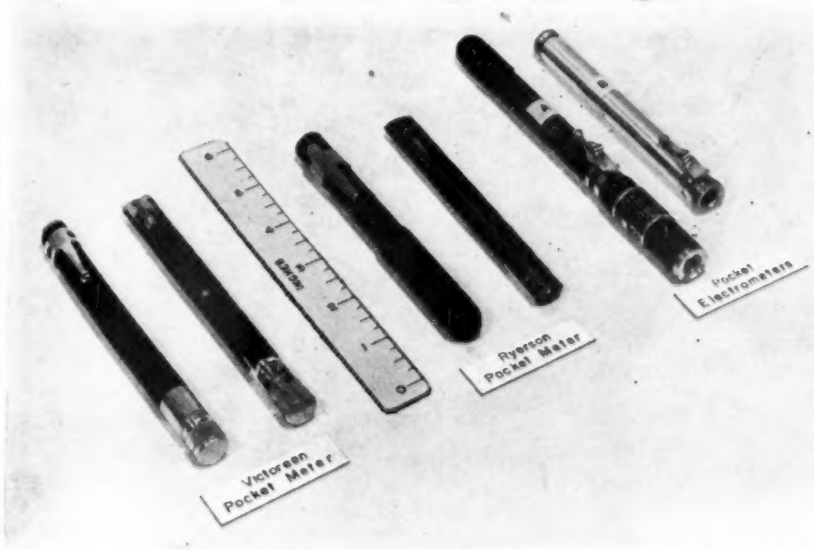
In an atomic-energy plant there are several hundred radioisotopes produced both by fission and by induction. Then there are the alpha, beta, gamma, and neutron radiations, each of which has presented many problems of detection, measurement, and radiation protection.

Safety Meters

The personnel monitoring section is responsible for the meters that are worn on each person that enters a radiation area. Film badge meters, pocket meters, and pocket electrometers are used for this purpose. The film badge has an open window and a portion is shielded by one millimeter of cadmium. Both gamma-sensitive and the neutron-sensitive film are enclosed in this meter. The gamma film packet has two films, a sensitive and an insensitive film.

From the blackening of the film as detected with a densitometer after it is developed, the health-physics technicians can estimate the radiation exposure of the person who used it. The reading of the film from behind the cadmium shield can be made in roentgens more or less independently of the energy of the gamma-ray photons, and the reading of the film from behind the open window can be used to estimate the beta-ray exposure and the low-energy gamma-ray exposure.

The neutron film is looked at with the aid of a dark-field microscope after it is developed. The fast neutrons that passed through the cadmium shield of



Two of these pocket meters are worn by each person in the radiation area to guard against the possibility of an inaccurate reading due to the discharge of a faulty meter.

the badge produced proton-recoil tracks on the film that can be counted with the aid of this microscope. The portion of this film that was behind the open window of the badge has protons producing tracks in it also. These are due to the capture of the slow neutrons by the nitrogen in the film which results in the ejection of a proton.

In this way one can tell what fraction of the exposure to the person was due to gamma rays, fast neutrons, and slow neutrons. Since tolerance levels and shielding requirements are different for each of these, it is necessary to measure their intensities separately. Frequently a person must place his hands closer to the radiation source than the rest of the body, so film rings are worn in such cases.

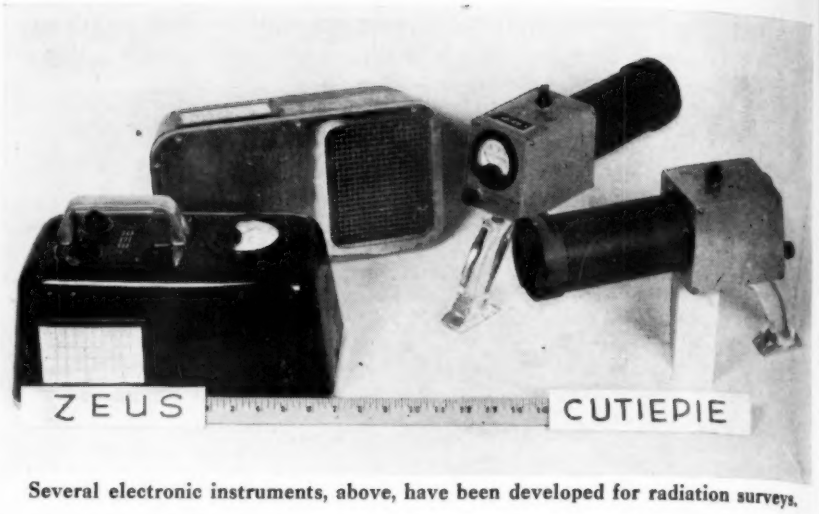
Two types of pocket meters are available. Each has its advantages. These meters can be read from 5 mr to 280 mr. Two are worn by each person who enters the radiation area, thereby reducing the probability of recording a false reading due to the discharge of a defective meter, and are read at the close of each shift with the aid of a minometer.

The pocket electrometers can be read directly by holding them up to the light and looking through the end at a small fiber. These meters are worn for work where the radiation level is very high and when the working time to receive a total daily tolerance exposure is a few minutes.

Radiation Surveys

The radiation survey section is responsible for ensuring that all areas in which people work and live, both inside and outside the operating areas, are maintained below the tolerance levels of radiation exposure. Various types of electroscope assemblies are used for making these surveys. Years of experience have shown that the electroscope is the most dependable of all instruments available for this radiation survey, and, until some equally reliable instrument is developed, it should be used to make the quantitative measurements of alpha, beta, gamma, and neutron radiations.

We have heard a great deal about Geiger-Müller, or G-M tubes, since their use at Bikini. I used them at Bikini, too, but I have also been using them and studying their behavior for the past fifteen years. This instrument is very useful as an indicating instrument because of its high sensitivity and extreme simplicity.



Several electronic instruments, above, have been developed for radiation surveys.

However, I would take strong issue with those who have recently described it as the principal radiation survey instrument. Some of its more serious disadvantages are: (1) it has a limited lifetime, (2) it changes calibration with use, (3) its operating voltage and plateau characteristics may change without warning, (4) it is photosensitive, (5) it is thermally sensitive, (6) it jams in intense fields of radiation and probably will read zero when it should indicate a dangerous radiation hazard, and (7) it is energy dependent, so that it does not read roentgens unless one knows what the source of radiation is. In spite of all this, it is one of the best instruments for detecting the presence of radiation.

There are many varieties of G-M tube portable circuits in use on the atomic-energy projects. Having located radiation with the aid of a G-M tube, the electroscope should be used to make the final measurement.

There are many other useful applications of G-M tubes. One of the fourfold hand and foot counters uses an arrangement of G-M tubes, scalers, and recorders to record automatically the radiation level on the hands and feet of a person in twenty-four seconds. Certain doorways use a so-called "octopus circuit" with G-M tubes arranged about it and connected to a circuit that gives an alarm if one passes with much radioactive contamination on his body or clothing. Another common use of G-M tubes is to check the clothes in the decontamination laundry where they are washed with citric acid and detergents to remove the radioisotopes.

Protective Clothing

Sometimes when there is a great deal of radioactive contamination in an area, special protective clothing is required to prevent the radioisotopes from contacting the body. Special hoods and masks must be worn to prevent inhalation of the radioisotopes that are suspended in the air. Remote control instruments are used frequently.

The monitron is an electronic instrument that records continuously the radiation level in the area by marking on a piece of moving tape, and it sounds an alarm when the radiation flux exceeds a safe value.

Just a few of the responsibilities of the health physicists have been mentioned. Health physicists are needed in time of war as well as during peace. The great need of men with training and experience was forcibly demonstrated at Bikini. So far, only feeble and half-hearted efforts have been made by the Army and Navy to train senior health physicists, and up to the present date there are no men with such training in our armed forces.

These are the men that must decide what are the hazards in entering a city after it has been atomic-bombed, what instruments must be used for a particular survey, what the tolerance level is for a particular radioisotope, when the radioactive contamination of water is sufficiently low that it can be used for human consumption, when masks must be worn if our troops are to survive. It takes years to train a senior health physicist, and this training program has not yet begun.

Men Against the Snows

The terrain of America encompasses everything from jungle to Arctic, from deserts to mountains. That is why the Army has in being such special units as ski and mountain troops skilled in travel and maneuver under the worst winter conditions and over the most precipitous ground. These units proved their worth in the bitter Italian campaign of the last war in reconnaissance and patrolling activity. The knowledge and experience that they have amassed will be invaluable. With the growing importance of the polar areas, America's northern defenses can be made secure by men with the ability and equipment to fight over the snows.

This fully equipped trooper has been trained by experts in all the techniques necessary for mountain climbing.

Ski troopers must not only be capable of swift movement over the snow but must learn how to apply weapons and firepower accurately on a moment's notice

These ski troopers are practicing their skill over rough territory. Their uniforms are designed to blend with the snow for protection and security.

One of the first maneuvers novices are taught is "stemming," a means of braking their speed and controlling their direction.

Another position of primary ski training is the "herringbone." By s slanting the edges against the slope, the troopers can climb a hil

Cross-country mobility of men and weapons is of prime importance. T guns mounted on sleds, along with ammunition and supplies. Note

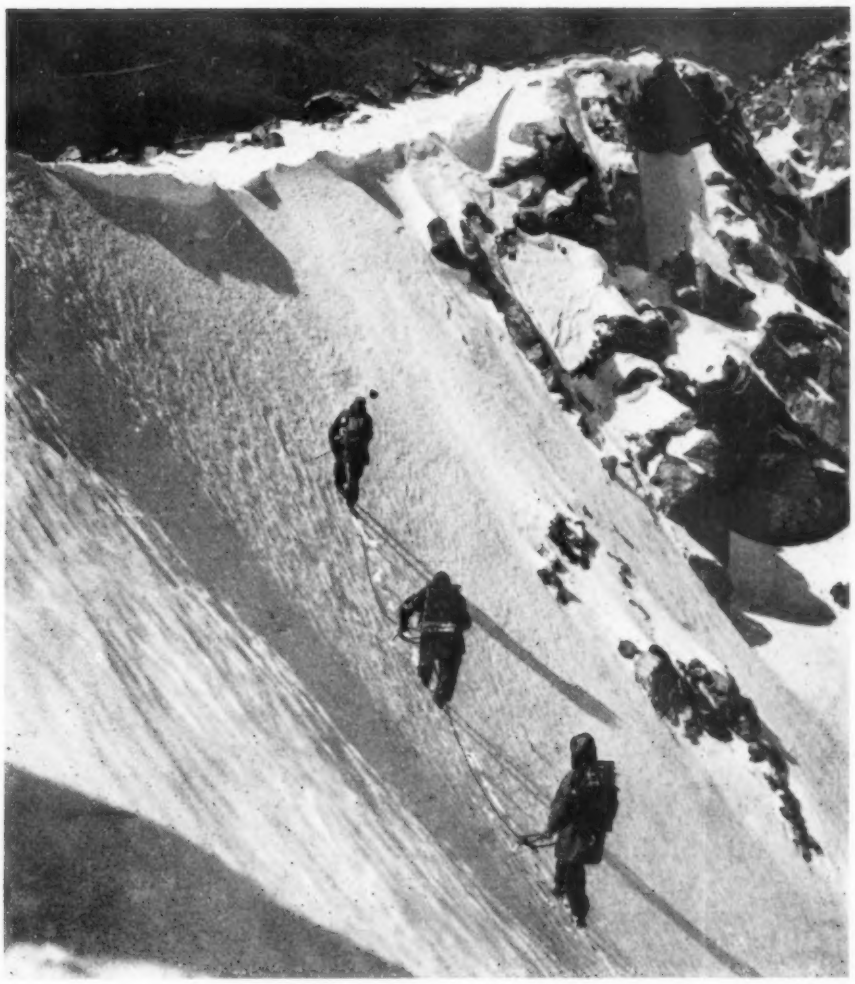
This BAR man is fully equipped for combat. Notice how the rifle fits nicely on the right side of the rucksack, making it very easy to carry.

These para-ski troopers are lying in firing positions whic mediately without being hampered or delayed either by

ngbone." By spreading the tips of the skis apart and
an climb a hill with relative ease without slipping.

portance. These men are hauling caliber .30 machine
plies. Note the special towing harness being used.

ions which they can go into almost im-
either by their equipment or the snow.



These instructors from the Army's Mountain and Winter Warfare School are climbing a snow-covered peak, determining methods to be used in training the students.

The hazards of mountain climbing are clearly shown in the tenseness of the men in helping their partner up over a treacherous lip of snow onto safe ground.

This instructor carefully guides his student, left, over the edge of a mountain wall onto a level shelf. All the techniques and experience gained in peacetime climbing are used. Below, the versatility of the ski trooper is shown by his ability to deliver fire from a standing position while carrying equipment.

Above, this para-ski trooper, having just landed by parachute, immediately adjusts his skis to be ready for any kind of terrain he might encounter. Right, the war-developed Weasel, designed for snow mobility, takes the place of sled dogs and can haul many sleds filled with men and supplies over snowbound country.

(Army photos)

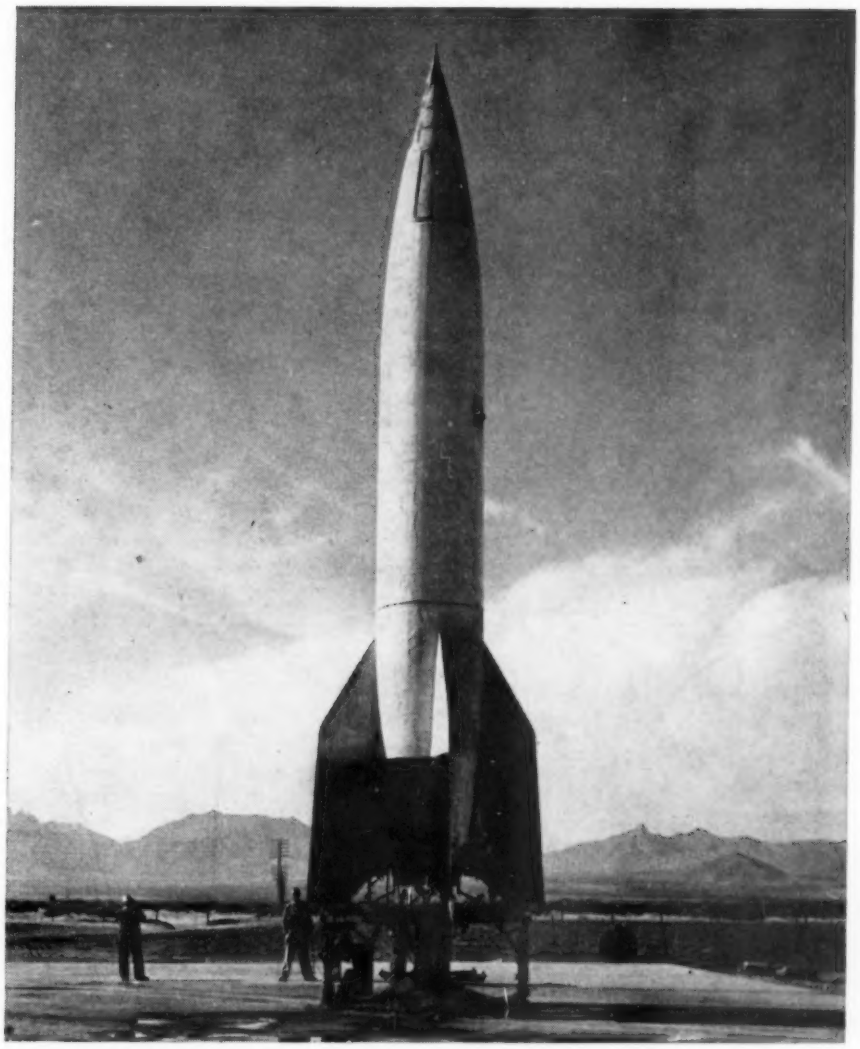
Limitations of the Long-Range Missile

by

Willy Ley

Internationally known authority on rockets and guided missiles

The new rockets are only added weapons to our arsenal of arms—they can never be a substitute for any or all of the others



THE technology of a period has always influenced its wars, but for many centuries technological innovations evolved piecemeal and so slowly that military men as a whole always felt themselves to be self-sufficient. Until about the end of the Civil War, technology merely influenced but never dominated the military "art."

But then the picture began to change, and, partly because of some inventions that had been made during the Civil War, technology and engineering began to emerge as the dominant factors. The problem for the military man no longer was how he could use technological innovations to his advantage but how he could adapt tactics and strategy to the existing facts of technology.

A by-product of this profound change since then was the ever-recurring but ever-mistaken belief that all, or at least nearly all, hope could be placed in a new weapon.

The most spectacular developments of World War II were the atomic bomb, radar, the proximity fuze, and the long-range missile. And now one more group of prophets begins to appear, trying to tell us that the long-range missile, guided by radar, with an atomic war head and a VT fuze, is spelling (a) the end of artillery, (b) the end of surface fleets, and (c) the end of surface structures in general.

While it is probably true that the fission bomb itself, if used in large quantities, would spell the end of surface structures both on land and sea, it might be useful to examine the limitations placed by engineering and natural laws upon the long-range missile which might carry such a bomb.

The Meaning of "Long Range"

The emphasis is on the term "long range." And the term "long range" is meant to comprise any distance beyond a minimum of 200 miles, a figure chosen because 200-mile-range missiles are already in existence and because this figure eliminates any comparison with artillery fire. It is, at this moment, more or less impossible to design a 200-mile gun. If it could be done, we can be reasonably certain that such a gun would not be a practical weapon.

The reduction of a target 200 miles distant can at present be accomplished in two ways. One is aërial bombardment by piloted bombers. It is comparatively unimportant whether the air-to-ground weapon used by the bombers consists of conventional uncontrolled bombs, of gravity-powered controlled missiles like Azon, Razon, or Roc, or of missiles with additional propulsion. That is a choice exclusively determined by the nature of the target.

The other method is the long-range missile of which there are two specific types that are fundamentally different. The fundamental difference consists in whether they are, or are not, aërodynamically supported while traveling. The German V-1 was an example of an aërodynamically supported missile, while the German V-2 is an example of an aërodynamically unsupported missile. This difference determines whether the missile travels along a "flight path" like an airplane or along a trajectory like an artillery projectile.

The aërodynamically supported missile will travel most of the way at a predetermined altitude, and the ascending and descending path, just after take-off and just prior to impact, will account for only a small percentage of the range. Because such a missile has to stay at altitudes where the atmosphere affords support to its wings, it follows that defending fighter craft can go to the same altitudes. And no matter how high or how fast such a missile can travel, the fighter aircraft of the same period will be superior. This is true not only because the fighter plane is manned by a skilled pilot but also because it is slated to return to base after its mission. Its propulsion unit therefore can be made of much more costly materials and hence have a performance superior to that of the throw-away missile.

Interception Possible

The aërodynamically supported missile can also be intercepted by artillery and rocket fire from the ground. During the so-called "robot blitz" from June 12, 1944, to August 30, 1944, the Germans sent 8,070 V-1 missiles against London. Of these, about 2,000 malfunctioned at take-off and crashed just after leaving the launching ramps. About 4,000 were crashed or exploded in midair by active interception, with the number of "kills" about evenly divided between fighter planes and anti-aircraft fire from the ground (with some help from barrage balloons). Thus only 2,000 missiles reached London.

These figures, however, should not be used as a basis for evaluation of future possibilities since they are quite misleading. They cover the whole time interval of the "robot blitz," but as the defenders in the air gained skill and experience and the defenders on the ground were equipped with better gun directors allotted for this work, the percentage of casualties of the missiles increased to such an extent that during the last few days only about one in twenty evaded the defenses.

V-1's Really Expensive

At first glance, the aërodynamically supported missile looked like a very cheap weapon; the production of a V-1 was accomplished by the Germans at a price of between 800 and 900 man-hours. The production of a V-2 rocket cost them 13,000 man-hours. But if the rate of interception is nearly 95 per cent, the price of the missile which "gets through" is no longer 900 but 18,000 man-hours, which means that the work expended on two such successful missiles equals the work required to build three V-2 rockets. In the face of these facts, bomber squadrons with good fighter escorts might do much better than aërodynamically supported missiles.

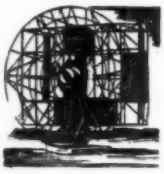
This consideration does not eliminate the aërodynamically supported missile completely, however. So far we have considered it, without specifically saying so, as a ground-to-ground missile with mostly land under its flight path where there are numerous possibilities for interception. And, of course, as the range increases, the interception gains the upper hand, mile for mile.

Things are likely to be different if such a missile is considered as a ship-to-ship weapon because the possibilities for interception at sea do not increase simply with the range as they do on land. It seems, therefore, that such missiles might become naval weapons rather than land-based ordnance, with the possible exception of specialized uses as shore batteries. Fired in the opposite direction as a ship-to-shore weapon, it would be almost as badly handicapped as it was in its original rôle as a ground-to-ground weapon.

If the aërodynamically supported missile follows a flight path like an airplane, the aërodynamically unsupported missile, the long-range rocket, follows a trajectory which differs not too much from the trajectory of a heavy projectile. There is no horizontal flight at all, but simply an ascending path which then changes into a descending path.

But while an artillery projectile falls at an angle which is not much steeper than the elevation of the gun from which it was fired, the long-range rocket falls almost vertically. This is caused mainly by the action of the external stabilizing fins against air resistance after the rocket reënters denser layers of the atmosphere on its downward path.

If a long-range rocket were fired at an angle like a gun, the ascending path would differ from that of a projectile by being much straighter as long as the rocket motor is working. But very large rockets cannot be fired at an angle for a number of reasons. They are fired vertically and are then slowly eased into the 45-degree angle for maximum range after they have acquired a sufficiently high velocity.



In the case of the V-2, after the rocket traveled vertically for the first eight or nine seconds, it was tilted slowly through forty-five degrees at the beginning of the fiftieth second and had then another fifteen to eighteen seconds of propulsion.

At the end of the propulsion time it traveled with a speed of almost precisely one mile a second, reaching its peak of trajectory at about 60 miles and crashing 300 seconds after take-off about 200 miles from the launching site.

The number of German failures was quite high, unpleasantly so for the inhabitants of the occupied countries (mostly Holland) from whence the Germans fired these rockets. About eight per cent of the rockets exploded at take-off or at altitudes that could be observed from the take-off area. An additional twenty-five per cent which seemed to behave properly did not reach the target city. They may have exploded at high altitudes or else failed to tilt sufficiently so that they attained a very high altitude but little range.

Premature Use

These failures did not prove much more than that a new invention was used prematurely and, possibly, that workmanship and inspection were not up to par. The most important advantage of the long-range rocket as compared with the V-1 was that it could not be intercepted once it had left the ground.

Theoretically it might be possible to intercept long-range rockets by counter-missiles, but it will probably be a long time until this theoretical possibility is translated into a workable reality.

Even interception at the source proved almost impossible since the long-range rocket did not require a long and stationary launching ramp like the V-1 but could be fired from any piece of reasonably hard ground measuring twenty by twenty feet and accessible to heavy motor transport. A motor transport could arrive somewhere, set up equipment, fire three rockets, and be on the move again in a little over two hours.

Because of its mobility and noninterceptability the long-range rocket is far superior to the aërodynamically supported missile as a long-range weapon. Actually it is hardly more expensive than the V-1 type, and it is even cheaper than bombardment aircraft which need ground crews, hangars, runways, maintenance, and a host of auxiliary services. But at present, and for a number of years to come, bombardment aircraft hold the edge as far as range is concerned. One might say that bombardment aircraft are the best long-range weapons, now and for the immediate future, but that the best long-range missile will be the long-range rocket.

The long-range rocket itself is also subject to a number of limitations. Its range, like the range of a projectile, depends on the velocity which it attains. A projectile is accelerated for the distance from gun breech to gun muzzle; the rocket is accelerated until *"Brennschluss,"* as the moment of fuel cut-off has been called. (The German term has been adopted because it means only that, while the English translation of that term, "burn-out," may also mean the burning out of the motor and therefore cause misunderstandings.)

It is therefore necessary to compare the muzzle velocity of a projectile to the rocket velocity at *Brennschluss,* and the rocket here has the advantage of having already traveled some distance toward the target when that moment occurs. All the aiming or guiding has to be done during this time interval, which in the case of the V-2 rocket is just short of 70 seconds and which is not very likely to exceed 120 seconds in any instance.

Control Difficulties

If we had a rocket for very long ranges, say 600 miles, it would be still accelerating at a considerable distance from its take-off point. The distance, measured along the trajectory, which such a rocket has traveled up to *Brennschluss* may be estimated to be as high as eighty miles, and it would require some rather powerful controls to do additional guiding over this distance.

After *Brennschluss* no guiding is possible until the rocket enters denser layers of the atmosphere again. And while guiding on the downward path is possible it would hardly be feasible most of the time because the rocket is then rather close to the target area which, of course, will be under enemy control. And since the rocket, at the time when guiding becomes possible again, will be less than 150,000 feet high, even the nearest friendly guiding station will be far below the horizon.

If the problem of guiding over very long ranges is one of the limitations of the long-range rocket, the danger of "incineration" is another one. While London was under V-2 fire, some ARP men reported on occasion that they had seen a descending V-2 rocket glowing a dull red.

If the stories of these sharp-eyed air-raid wardens were doubted at first, subsequent investigation vindicated them. It was found that such a rocket might heat up to temperatures at which it would be just visible. As a matter of fact, the choice of the explosive, Amatol, which is rather insensitive to heat, had been prompted by this consideration.

Naturally it will be possible to insulate the explosive charge to some extent, and the problem of "incineration" may not present insurmountable difficulties for ranges of 600 and 1,000 miles, maybe not even at 2,000 miles. But they may become insurmountable if ranges of 8,000 miles or more are contemplated.

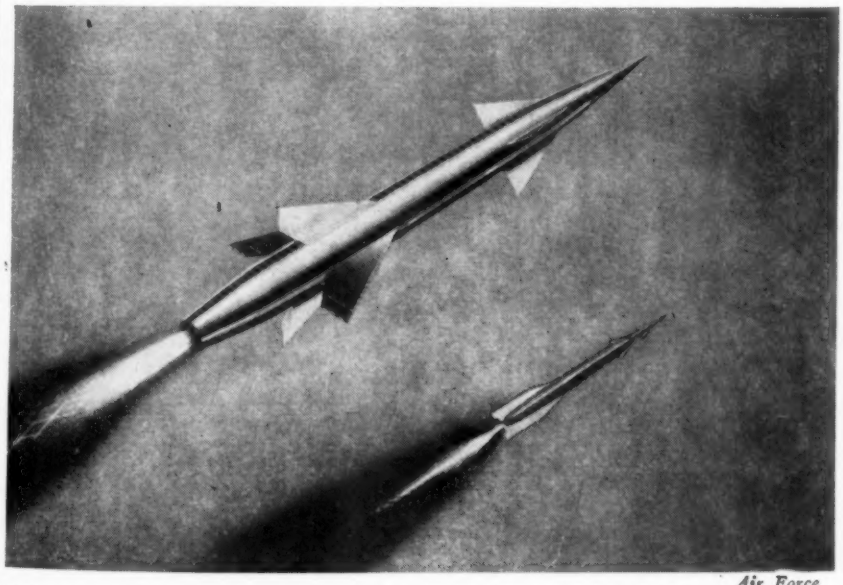
Finally there is a limitation in practical take-off size. To attain high velocities for long ranges the rocket needs a large fuel supply.

Excessive Take-Off Weights

A shot of over 250 miles would require a mass-ratio of almost 4 to 1, while a shot over 630 miles would require a mass-ratio of about 6 to 1. If we could simply assume that the empty rocket with a war head weighs 4 tons like the V-2, the respective take-off weights would be 16 and 24 tons. But larger tanks for a larger fuel supply naturally weigh more, so that the empty rocket with war head would probably weigh 4½ tons in one case and 6 tons in the other. This means that the take-off weights would be 18 tons in one case and 36 in the other.

These rockets would still carry only a one-ton war head. If we wanted three-ton war heads with proportionately heavier rockets the empty weights would jump to about 10 tons and 14 tons. This would result in take-off weights of 40 tons for the 250-mile shot and 84 tons for the 630-mile shot. Both these take-off weights are still in the realm of possibility.

Like any other weapon, the long-range rocket is subject to a number of inherent limitations. Because of these limitations the long-range rocket is an *additional* weapon in the arsenal, but cannot replace either artillery or bombardment aircraft.



Air Force

Engineering and natural laws will always limit the size and scope of war rockets.

Month by Month: A Review of the National Defense Situation

REARMAMENT ORDERS

Rearmament orders have started to move and will increase in volume during the latter part of the year. One-seventh of the fourteen-billion-dollar total has been placed in aircraft orders. These are to be expanded more than this amount within the next six months. Defense security rules are believed to conceal another billion and a half dollars in orders not yet made public.

Industrial executives in several durable-goods fields consider that orders have not come up to expectations. Earlier in the year, for example, machine-tool builders said they had been assured that at least $600,000,000 worth of new tools would be ordered this year. It is now estimated that sales will be at least $200,000,000 short of this amount.

There has been some criticism of the armed forces policy of assigning purchase orders by industrial districts in a ratio aimed at maintaining a distribution of orders equal to the percentage of plant capacity in each area. A struggle has also appeared over the methods of issuing allocations of scarce metals for use on defense contract production.

The present demand from industry for early action on rearmament contracts indicates a desire to have a cushion against a possible recession in 1949.

ATOMIC ENERGY REPORT

The greater part of the fourth semi-annual report of the U. S. Atomic Energy Commission is devoted to the use of isotopes in tracer research.

Isotopes for scientific, medical, agricultural, and industrial use constitute the first great contribution of the development of atomic energy to peacetime welfare.

Industrial power from nuclear energy may be a decade or longer in the future, and most other applications are still largely speculative. But isotopes produced at the Oak Ridge atomic-energy establishment are already at work in more than 300 laboratories and hospitals in this country and abroad, adding to man's store of knowledge about himself and the world around him.

Isotopes assist science in two ways: as sources of radiation for many potentially important uses, including the treatment of disease, and as tracers of processes formerly difficult or impossible to observe. As tracers, they are proving themselves the most useful new research tool since the invention of the microscope in the seventeenth century. They represent that rarest of all scientific advances, a new mode of perception.

Using tracer isotopes, the scientist and engineer can now observe atoms as they take part in basic organic and inorganic reactions, much as though the atoms were visibly tagged or labeled.

New as it is, tracer research has already broadened our understanding of many fundamental processes of nature. Medical men are already profiting from a better understanding of the working of the human body. For the future, isotopes will speed the battle against disease. They will help us to make more efficient use of nature's materials to grow more food and to produce better manufactured goods.

SEVENTY-GROUP AIR FORCE

The Air Force's program to rebuild seventy combat-efficient groups is proceeding on schedule.

Present appropriations provide for sixty-six groups to be organized by June 30, 1949. Activation of the four remaining groups—two troop-carrier and two medium-bomber groups—has been set back to fiscal year 1950 because the Army units with which they will function are not scheduled to be in operation until then.

Of the sixty-six groups, fifty-five, plus seventeen separate squadrons, had been organized by January 1, 1948. The Eightieth Congress authorized eleven additional combat groups, plus five separate squadrons, to be organized by June 30, 1949.

The composition of the scheduled 66-group Air Force by groups is as follows: 2 heavy-bomber; 18 medium-bomber; 3 light-bomber; 22 fighter; 3 all-weather fighter; 6 strategic-reconnaissance; 4 tactical-reconnaissance; 3 heavy troop-carrier; and 5 light troop-carrier groups.

Secretary of Defense Forrestal recently approved an Air Force request for the release of $103,600,000 of withheld 1948-1949 aircraft appropriations to order 213 additional jet fighters and reciprocating-engined bombers.

LEADERSHIP CHANGES

One of the Nation's outstanding wartime producers of military equipment, Reginald E. Gillmor, was recently appointed Vice-Chairman of the National Security Resources Board.

Mr. Gillmor, president of the Sperry Gyroscope Company, was formerly director of the industry division of the American Mission to Greece. In his new rôle as assistant to Arthur Hill, Chairman of NSRB, Mr. Gillmor will supervise the work of the board's mobilization-planning staff. This staff is comprised of the Offices of Production, Transportation and Storage, Human Resources, and Economic Management.

In another significant change, Donald F. Carpenter of Remington Arms Company was appointed Chairman of the Munitions Board, succeeding Thomas J. Hargrave.

Mr. Carpenter was Secretary of Defense Forrestal's deputy on atomic-energy matters and chairman of the Military Liaison Committee to the Atomic Energy Commission.

Mr. Hargrave held the Munitions Board chairmanship on leave of absence as president of Eastman Kodak Company. In accepting his resignation, President Truman expressed sincere thanks to Mr. Hargrave for the "fine service" he had rendered since his appointment to the board in May 1947.

TANKS RECONDITIONED

War-battered tanks by the hundreds from battlefields all over the world are getting a complete face lifting in a new program to build up America's armored forces.

Rusted and shell-splattered, the tanks limp into the Army's vast Detroit Arsenal production plant. Days later they roar out, rebuilt down to the last bolt, gleaming with fresh paint, and bristling with added power.

A production rate of about fifty a month will be reached soon. By next summer the rate will be increased to approximately fifteen per cent of the plant's wartime potential.

Scheduled for production next year is an entirely new medium tank, the General Patton. Its characteristics are still on the secret list, but indications are that it will be speedier and tougher than anything the Army has ever put in the field.

The rumble of presses and hum of lathes at the arsenal is the Army's answer to those who say that tanks are obsolete in this age of long-range aircraft and atomic bombs.

STANDARDIZED MILITARY EQUIPMENT

The development of a common catalogue system and standardized equipment for the armed services has started. Orders have been issued establishing the Munitions Board Cataloguing Agency and the Munitions Board Standards Agency.

The task of the Cataloguing Agency is to coördinate the efforts of the Army, Navy, and Air Force in the construction of a uniform catalogue of all items used by the Military Establishment in peace and war. Each item will be provided a single name, description, and identification number, and will be classified in but one supply commodity class.

The function of the Standards Agency is to develop unified agreement on National Military Establishment specifications and engineering standards and to develop agreements among the Army, Navy, and Air Force on standard designs of equipment and component parts.

SPECIALIST COMMISSIONS

Civilians experienced in any one of seventy-six broadly defined professional and technical specialties will be tendered commissions in the Army, if they apply and qualify.

The commissions range from those of second lieutenant up to and including colonel, depending upon the qualifications and experience the individual possesses in a given specialty. Applicants must be at least twenty-one years of age for initial appointment in the Reserve Corps, and applications will be considered from individuals up to fifty-five years. All must be citizens of the United States. No previous military experience is required.

In addition to the fields of medicine, engineering, accounting, education, transportation, and psychology, the list contains a wide variety of other civilian specialties which are very essential and immediately adaptable to the needs of the Army. They run the gamut from laundry and dry-cleaning specialists to experts in shipbuilding.

Application forms may be secured from local Reserve unit headquarters or Organized Reserve unit instructors, or by writing to Army headquarters at New York, Baltimore, Atlanta, Chicago, or San Francisco, or to the Adjutant General, Department of the Army, Washington 25, D. C.

INDUSTRIAL COLLEGE

The Industrial College of the Armed Forces is now recognized as being on the highest level in the educational field within the National Military Establishment. This well-deserved status was achieved September 30, 1948, when the college was placed under the direction of the Joint Chiefs of Staff.

In 1946, by action of the Secretaries of War and Navy, the name of the institution was changed from Army Industrial College to the Industrial College of the Armed Forces, and the college was placed under the administration of the Under Secretary of War and the Assistant Secretary of the Navy. This gave recognition to a long-existing fact that the college was really a joint Army-Navy institution.

The Industrial College has gone a long way since its foundation nearly a quarter of a century ago. Those who have observed its progress during the years are hopeful that under the direction of the Joint Chiefs of Staff the college will not lose those essentially *industrial* characteristics which it was founded to advance. If the college becomes predominantly military rather than industrial, one of the basic reasons for its very existence will be changed. Only time will tell whether this change of direction will be advantageous, for surely the indoctrination of Army, Navy, and Air Force officers with a basic understanding of industrial problems is still a crying need in our military-naval-air services. It is difficult to see how an essentially industrial college can be properly directed by the essentially military Joint Chiefs of Staff.

The newly defined scope of the college includes:

Orientation in the broad aspects of world political, economic, and power patterns;

Study of the economic potential for war of the nations of the world and of blocs of nations which might have special significance in peace or war and analysis of the relationship of the economic potential to political, military, and psychological factors in our national strategy;

Study and analysis of the organization and administration of the National Military Establishment and other Government agencies concerned with mobilization of the national economy for war and later reconversion to a peacetime basis;

Study of methods of formulation and means of implementation of joint logistic plans and the relation of these plans to joint strategic plans and to the economy of the Nation;

Study of the production aspects of mobilization of the national economy and analysis of those factors vitally affecting the production program during mobilization and reconversion;

Study of the procurement, production, and distribution aspects of mobilization for war and reconversion to a peacetime basis;

Study and analysis of man-power problems in connection with mobilization of the economy and of mobilization of the military forces;

Study and analysis of any phase of economic mobilization of the United States or foreign countries which is considered significant to the defense of the Nation.

TECHNICAL INFORMATION COMMITTEE

The formation of a Special Committee on Technical Information to promote the effective exchange of research and development information among the departments of the National Military Establishment was announced by Dr. Vannevar Bush, Chairman of the Research and Development Board, National Military Establishment.

The committee will study the problem of collecting, correlating, reproducing, and disseminating technical information potentially useful in the research and development program. The study and application of new methods and techniques to the problem of technical information organization and the promotion of active research in this effort are expected to receive attention.

Dr. Detlev W. Bronk, chairman of the committee, is president of Johns Hopkins University.

Peace, Security—and Survival

"TWO great peoples starting at different points go forward toward the same end: These are the Russians and the Americans. The others seem to have attained the limits that nature traced for them. These two alone go forward in a race of which the eye cannot see the limits.

"To attain his end, the American relies on the strength and reason of individuals; the Russian concentrates in one man all the power of society. The one has for his principal means of action liberty; the other servitude. Their points of departure are different; their paths are diverse. But each of them seems called by a secret design of Providence to hold one day in his hands the destinies of half the world."

Thus wrote Alexis de Tocqueville, the great French historian and essayist, *more than one hundred years ago.*

As of today, the United States of America is at a decided disadvantage with regard to man power, as compared with the Union of Soviet Socialist Republics, in the ratio of 143,000,000 to 193,000,000. And this disadvantage with regard to man power will tend to increase rather than decrease, according to House Document No. 754, Seventy-ninth Congress, Second Session:

"According to official prediction, within the 20-year period of development foreseen by Premier Stalin in his speech of February 9, 1946, the population of prewar Russia will reach 250,000,000. . . . By that time [1970] prewar Russia alone will have about 32,000,000 men between the ages of 20 and 34 years—with 22,000,000 of them in the ideal military-age group of 20 to 29 years.

"Within the same period, the population of the United States may reach 160,000,000 with 18,000,000 men between the ages of 20 to 34 years, about 10,500,000 of them between 20 and 29. The Soviet Union's 32,000,000 [military-age] men in 1970 will almost equal the combined military-age man power of the United States, Britain, France, Germany, and Italy."

In appraising the chances for success in a possible World War III, it is clearly apparent that our salvation does not, and will not, lie in superior man power. As in World War II, logistical superiority in firepower and mobility is the only possible way we can hope to offset our strategical inferiority in numbers.

Our salvation, our very existence—in fact the future of civilization itself—may well lie in our providing for ourselves and our probable friends munitions power superior in quality and quantity to that available to our probable enemies.

If we achieve this goal eventually, we will "win" eventually—only to find, as General Eisenhower says, that "resort to arms may leave the wilderness as the only conqueror." But if we *promptly* achieve an *obvious* retaliatory potential instantaneously available and overwhelmingly applicable, gangster nations will get the point. The only way to win a war today is to avert war altogether.

In the Atomic Age, adequate scientific and industrial preparedness is our best hope for PEACE, SECURITY—and SURVIVAL.

James L Walsh

President, American Ordnance Association.

Association Affairs

FULL STEAM AHEAD! The cold war finds the A.O.A. beginning its 1948-1949 schedule of activities with the throttle wide open . . . Industrial Preparedness Day (Remember Pearl Harbor, December 7th) will be marked by the Association with a mammoth dinner meeting to be held in the Grand Ballroom of the Waldorf-Astoria, New York, Monday evening, December 6, 1948 (see page announcement overleaf) . . . Members will receive personal invitations and full details early in November . . . The New York Post, under the direction of its president, Maj. C. Stewart Comeaux, will sponsor the meeting . . . Adm. Louis E. Denfeld, Chief of Naval Operations; Lieut. Gen. R. L. Eichelberger, formerly MacArthur's right-hand man in the Pacific; Maj. Gen. James M. Gavin, personification of airborne victory, will speak . . . Mark the date and place on your calendar now.

Plans for the Association's Thirty-first National Meeting next year are beginning to jell . . . Los Angeles, Calif., will be the place of the 2-day meeting to be held in the spring of 1949 . . . It will be the first time the A.O.A. has held an annual meeting on the Pacific Coast. H. L. Clark, well-known General Motors executive in Southern California who is president of the Los Angeles Post, A.O.A., will be in general charge. More later—including personal invitation to all members after January 1st.

WHAT TRAIL BLAZERS these Los Angeles Ordnanceites are! At a dinner meeting of the Post in August the nationally famous commentator Henry J. Taylor addressed a capacity audience (348 members and guests) at California Club. He was introduced by Lewis Allen Weiss, chairman, Mutual Broadcasting Company.

IN THE NATION'S CAPITAL the Washington Post has organized in a big way. President Foster Gleason announces the appointment of four important committees: Industrial Preparedness, Brig. Gen. R. C. Coupland, chairman; Public Information, R. L. Eichberg, chairman; Technical Progress, Capt. Frank J. Jervey, chairman; Student Activities, Dr. S. G. Green, newly appointed director, chairman.

THAT BRINGS UP the A.O.A. Manual on Local Posts. There's a honey for you! Copies have been mailed to the officers and directors of all Posts . . . Here for the first time are published the complete words and music of Post operation. How do you organize a Post? (See the Post Manual page 9.) How is a Post financed? (See the Post Manual page 10.) What can the Post officials do about maintenance of membership? (See the Post Manual page 17.) Every Post official—old and new—will want to keep his copy of the Post Manual in the upper right-hand drawer of his desk. It will give many of the answers—and also a little inspiration now and then to go places.

DON'T MISS THE NEW STUDENT ACTIVITIES MANUAL, either. Col. Bill Wright, chairman, Student Activities Committee, Chicago Post, is its author. It tells the complete story of A.O.A. plans and procedures for stimulating ordnance interest among the engineers and executives of tomorrow . . . You will hear more about this campaign as we go forward. Just now the Manual is being distributed by national headquarters to all Post officials and school and college authorities. Maybe you would like to have a copy for your own use in advancing the Ordnance cause among the young men at your alma mater.

WHICH BRINGS UP the topic of honors among student activities. In accordance with custom, the A.O.A. presented medals and plaques to honor students and teams at the annual Ordnance R.O.T.C. Camp at Aberdeen Proving Ground last summer. Here's the box score:

Plaques were awarded to the following: Outstanding school—University of California; Marksmanship—Michigan State College; Softball—University of Cincinnati; Volley ball—Georgia Tech.

Silver medals were conferred as follows: Outstanding cadet—John F. G. Eichorn, Jr., University of Maine; Outstanding scholar—John C. Floyd, Jr., Louisiana State University; Outstanding athlete—Fred M. Evens, Jr., University of Tennessee; Marksmanship, high score—Howard A. Aronson, Michigan State College.

Bronze medals were presented as follows: Marksmanship, 2nd place—Robert F. Jenson, Michigan State College; marksmanship, 3rd place—Harold L. Robinson, Michigan State College; 100-yard dash—George Cofejohn, University of Cincinnati; 220-yard dash—Jessie R. Bell, University of Oklahoma; 880-yard run—James C. Martin, University of Nebraska; high jump—Eldon C. Kennedy, University of Cincinnati; broad jump—Ilo P. Harvey, Penn State College; shotput—Robert E. Barrie, University of Vermont; discus throw—Robert D. Klemme, University of Tennessee; member, winning 880-yard relay team—William V. Davis, Walter T. Jerkins, Robert H. Thomas, Robert G. Wilkerson, Georgia Tech; 50-yard free-style swim—Michael T. Kennedy, University of Cincinnati; 100-yard free-style swim—Michael T. Kennedy, University of Cincinnati; 50-yard breast stroke—Hugh F. Eakin, University of Tennessee; diving event—Fred M. Evens, Jr., University of Tennessee; tennis match—Phillip C. McMasters, Cornell University.

NEW YORK POST held a directors' meeting at the U. S. Military Academy, West Point, N. Y., on October 15 and 16, 1948. The host was Maj. Gen. Maxwell D. Taylor, famed Superintendent at the Academy. Maj. C. Stewart Comeaux, energetic president of the Post, presided at dinner at the Hotel Thayer where General Taylor was the principal speaker. An important agenda of Post activities was considered and acted upon.

Not to be outdone, the directors, Council, chairmen of committees, and Post presidents of the A.O.A. met at the Metropolitan Club, Washington, for the fall meeting of the executive committee on October 7, 1948. President James L. Walsh presided at the business meetings throughout the day. At noon, Rear Adm. Albert G. Noble, Chief of the Bureau of Ordnance, Department of the Navy, addressed the officers and committee members. Following the directors' meeting that afternoon, President Walsh was host at dinner when Secretary of Defense James Forrestal and our Executive Committee member, Reginald E. Gillmor spoke. Reg Gillmor, of the Sperry Corporation, N. Y., is now deputy chairman of the powerful National Security Resources Board.

NEXT DAY the group journeyed to the U. S. Naval Academy as guests of the Superintendent, Rear Adm. J. L. Holloway. The admiral greeted the party, had them shown the principal points of interest at the great naval school on the Severn, including the chapel. A most impressive sight was the march-past of the Midshipmen. A most instructive visit was made to the Department of Ordnance and Gunnery where Capt. M. A. Sawyer, head of the department, was host. Following luncheon at North Severn Officers' Club where President Walsh spoke warmly to Admiral Holloway and his staff of the high regard the Association has for the Academy, for Naval Ordnance, and the Navy itself, the Ordnanceites spent the afternoon in the great naval research establishment which faces the Academy across the beautiful Severn . . . We started by saying that the A.O.A. throttle is wide open! Right? The accelerator is on the floor boards!

Announcing . . . . .

INDUSTRIAL PREPAREDNESS DINNER MEETING

American Ordnance Association

Grand Ball Room

THE WALDORF-ASTORIA, NEW YORK

on the

Eve of Pearl Harbor Day

Monday, December 6, 1948

under auspices of the

New York Post, A.O.A.

Reserve this date

MONDAY, DECEMBER 6, 1948

Special invitation and full details will be sent to all members in due course.

At this meeting the Ordnance fraternity will assemble to chart

The Road to Peace

Honor Roll of Industrial Preparedness

The Company Members of the American Ordnance Association appearing on the following roster are coöperating with the Association in its work for national security and peace. These Company Members, by nominating ten of their key employees for individual membership in the A.O.A., are forming a nucleus of trained men who will be a bulwark of preparedness for the national defense of the United States.

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ABBOTT BALL COMPANY . . . . . HARTFORD
A. C. SPARK PLUG DIVISION, GMC . . . . . FLINT
ACF-BRILL MOTORS COMPANY . . . PHILADELPHIA
ACME-LEES DIVISION, THE SERRICK CORP. . MUNCIE
ACME STEEL COMPANY . . . . . CHICAGO
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ADVANCE STAMPING COMPANY . . . . . DETROIT
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ÂEROJET ENGINEERING CORPORATION . . . AZUSA
AETNA-STANDARD ENGINEERING CO. . YOUNGSTOWN
AIR REDUCTION SALES COMPANY . . . NEW YORK
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AKRON-SELLE COMPANY . . . . . AKRON
ALL METAL PRODUCTS COMPANY . . . WYANDOTTE
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ARMOUR RESEARCH FOUNDATION . . . . CHICAGO
ARMSTRONG CORK COMPANY . . . . LANCASTER
ARMSTRONG RUBBER COMPANY . . WEST HAVEN
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ATLAS POWDER COMPANY . . . . . WILMINGTON
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AUSTIN POWDER COMPANY . . . . . CLEVELAND
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AUTOMOTIVE STAMPING & MANUFACTURING COMPANY . . . . . DETROIT

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B. G. MACHINE COMPANY . . . . . NEW HAVEN

Honor Roll of Industrial Preparedness

B

BAGLEY & SEWALL COMPANY . . . . WATERTOWN
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BAKER OIL TOOLS, INC. . . . . LOS ANGELES
BALDWIN COMPANY . . . . . CINCINNATI
BARLOW & SEELIG MANUFACTURING COMPANY RIPON
BARNES COMPANY, W. F. & JOHN . . . ROCKFORD
BASTIAN-BLESSING COMPANY . . . . . CHICAGO
BATAVIA BODY COMPANY . . . . . BATAVIA
BAUER BROTHERS COMPANY . . . . SPRINGFIELD
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BELL & HOWELL COMPANY . . . . . CHICAGO
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BELOIT IRON WORKS . . . . . BELOIT
BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY . . . . . ELYRIA
BETHLEHEM STEEL CORPORATION . . . BETHLEHEM
BETTER BRUSHES, INC. . . . . PALMER
BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY . . . . . BIRDSBORO
BIRTMAN ELECTRIC COMPANY . . . . . CHICAGO
BLACK & DECKER MANUFACTURING COMPANY TOWSON
BLACKMER PUMP COMPANY . . . GRAND RAPIDS
BLANCHARD MACHINE COMPANY . . . CAMBRIDGE
BLAW-KNOX COMPANY . . . . . BLAWNOX
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BORG-WARNER CORPORATION . . . . . CHICAGO
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BREEZE CORPORATIONS, INC. . . . . NEWARK
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BRIDGEPORT BRASS COMPANY . . . . BRIDGEPORT
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BUDD COMPANY . . . . . PHILADELPHIA
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BULOVA WATCH COMPANY . . . . . NEW YORK
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BURKE COMPANY, O. W. . . . . DETROIT
BURKEY UNDERWEAR COMPANY . . . HAMBURG
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CADILLAC MOTOR DIVISION, GMC . . . . DETROIT
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CARTER CARBURETOR CORPORATION . . ST. LOUIS
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CATERPILLAR TRACTOR COMPANY . . . PEORIA
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CENTRAL CAN COMPANY . . . . . CHICAGO
CENTRAL FOUNDRY COMPANY . . . . NEW YORK
CENTRAL STEEL TUBE COMPANY . . . CLINTON
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CHICAGO MALLEABLE CASTINGS COMPANY . CHICAGO
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CHRISTEN & SONS COMPANY, FRED . . . TOLEDO
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CHRYSLER MOTOR PARTS CORPORATION . . DETROIT
CHRYSLER SALES CORPORATION . . . . DETROIT
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CLARK GRAVE VAULT COMPANY . . . COLUMBUS
CLARY MULTIPLIER CORPORATION . . LOS ANGELES
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CLEVELAND GRAPHITE BRONZE COMPANY . CLEVELAND
CLEVELAND HARDWARE AND FORGING COMPANY . . . . . CLEVELAND
CLEVELAND HOBBING MACHINE COMPANY . . EUCLID
CLEVELAND STEEL BARREL COMPANY . . CLEVELAND
CLEVELAND TWIST DRILL COMPANY . . CLEVELAND
CLEVELAND WELDING COMPANY . . . CLEVELAND
CLOVER MANUFACTURING COMPANY . . NORWALK
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COCA-COLA COMPANY . . . . . ATLANTA
CODMAN COMPANY, F. L. AND J. C. . . ROCKLAND
COGSDILL TWIST DRILL COMPANY . . . . DETROIT
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COLUMBUS BOLT & FORGING CO. . . . COLUMBUS
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COMMERCIAL CARRIERS, INC. . . . . DETROIT
COMMERCIAL SOLVENTS CORPORATION . NEW YORK
CONCO ENGINEERING WORKS, DIVISION H. D. CONKEY & COMPANY . . . . MENDOTA
CONDENSER SERVICE & ENGINEERING COMPANY . . . . . HOBOKEN
CONTAINER CORPORATION OF AMERICA . . CHICAGO
CONTINENTAL FOUNDRY & MACHINE COMPANY . . . . . EAST CHICAGO
CONTINENTAL MOTORS CORPORATION . . . DETROIT
COPPERWELD STEEL COMPANY . . . . . WARREN
CORBITT COMPANY . . . . . HENDERSON
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CORO, INC. . . . . NEW YORK
CRANE COMPANY . . . . . CHICAGO

Honor Roll of Industrial Preparedness

8

CRIBBEN AND SEXTON COMPANY . . . . CHICAGO
CROSS COMPANY . . . . . DETROIT
CROWN CORK & SEAL COMPANY . . . BALTIMORE
CUSHMAN MOTOR WORKS . . . . . LINCOLN
CUTLER-HAMMER, INC. . . . . MILWAUKEE

DALTON FOUNDRIES, INC. . . . . WARSAW
DARLING VALVE & MANUFACTURING COMPANY . . . . . WILLIAMSPORT
DAVIS COMPANY, H. B. . . . . BALTIMORE
DAYTON RUBBER COMPANY . . . . . DAYTON
DEARBORN CHEMICAL COMPANY . . . . CHICAGO
DEERE & COMPANY . . . . . MOLINE
DEFIANCE AUTOMATIC SCREW COMPANY . DEFIANCE
DELCO PRODUCTS DIVISION, GMC . . . . DAYTON
DELTA MANUFACTURING COMPANY . . MILWAUKEE
DESOTO MOTOR CORPORATION . . . . DETROIT
DETROIT AUTOMOTIVE PRODUCTS CORP. . . DETROIT
DETROIT BRASS & MALLEABLE WORKS . . . DETROIT
DETROIT DIESEL ENGINE DIVISION, GMC . . DETROIT
DETROIT HARVESTER COMPANY . . . . DETROIT
DETROIT LUBRICATOR COMPANY . . . . DETROIT
DETROIT STEEL PRODUCTS COMPANY . . . DETROIT
DETROIT TRANSMISSION DIVISION, GMC . . DETROIT
DEVLIEG MACHINE COMPANY . . . . . DETROIT
DEXTER COMPANY . . . . . FAIRFIELD
DIAMOND TOOL COMPANY . . . . . CHICAGO
DICK COMPANY, A. B. . . . . CHICAGO
DIEHL MACHINE WORKS, INC., G. M. . . . WABASH
DIESEL EQUIPMENT DIVISION, GMC . GRAND RAPIDS
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DRAPER CORPORATION . . . . . HOPEDALE
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DURHAM MANUFACTURING CORPORATION . . MUNCIE
DURIRON COMPANY . . . . . DAYTON
DUTTON COMPANY, C. H. . . . . KALAMAZOO

EASTERN STAINLESS STEEL CORPORATION . BALTIMORE
EASTERN TOOL & MANUFACTURING COMPANY . . . . . BELLEVILLE
EASTMAN KODAK COMPANY . . . . ROCHESTER
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EDISON, INC., THOMAS A. . . . . WEST ORANGE
EKCO PRODUCTS COMPANY . . . . . CHICAGO
ELASTIC STOP NUT CORPORATION OF AMERICA . UNION
ELECTRIC AUTO-LITE COMPANY . . . . TOLEDO
ELECTRIC FURNACE COMPANY . . . . . SALEM
ELECTRIC SPECIALTY COMPANY . . . STAMFORD
ELECTRIC SPRAYIT COMPANY . . . . SHEBOYGAN
ELECTRIC STORAGE BATTERY COMPANY PHILADELPHIA
ELGIN NATIONAL WATCH COMPANY . . . ELGIN
EMERSON ELECTRIC MANUFACTURING COMPANY . . . . . ST. LOUIS
EMERSON RADIO & PHONOGRAPH CORPORATION . . . . . NEW YORK
ENGINE PARTS MANUFACTURING COMPANY. CLEVELAND
ENGINEERING RESEARCH INSTITUTE . . ANN ARBOR
ENGINEERS SPECIALTIES DIVISION, UNIVERSAL ENGRAVING & COLORPLATE COMPANY . . BUFFALO
ESTEY ORGAN COMPANY . . . . BRATTLEBORO
EVANS' SONS, INC., JOHN . . . . PHILADELPHIA
EXACT WEIGHT SCALE COMPANY . . . COLUMBUS
EX-CELL-O CORPORATION . . . . . DETROIT

FAIRBANKS, MORSE & COMPANY . . . . BELOIT
FALK CORPORATION . . . . . MILWAUKEE
FALLS SPRING & WIRE COMPANY . . . . DETROIT
FARBER, INC., S. W. . . . . BROOKLYN
FARGO MOTOR CORPORATION . . . . . DETROIT
FARQUHAR COMPANY, A. B. . . . . YORK
FAY COMPANY, C. E. . . . . BOSTON
FAYETTE MANUFACTURING COMPANY . . . FAYETTE
FEDERAL LABORATORIES, INC. . . . . PITTSBURGH
FEDERAL MACHINE AND WELDER COMPANY . WARREN
FEDERAL MOTOR TRUCK COMPANY . . . . DETROIT
FEDERAL SCREW WORKS . . . . . DETROIT
FELT AND TARRANT MANUFACTURING COMPANY . . . . . CHICAGO
FERRACUTE MACHINE COMPANY . . . BRIDGETON
FERRO MACHINE & FOUNDRY, INC. . . CLEVELAND
FIRESTONE TIRE & RUBBER COMPANY . . . AKRON
FISHER BODY DIVISION, GMC . . . . . DETROIT
FISHER-PRICE TOYS, INC. . . . . EAST AURORA
FLANNERY BOLT COMPANY . . . . . BRIDGEVILLE
FOLLANSBEE STEEL CORPORATION . . . PITTSBURGH
FORD INSTRUMENT COMPANY . . LONG ISLAND CITY
FORD MOTOR COMPANY . . . . . DEARBORN
FOSTER MACHINE COMPANY . . . . WESTFIELD
FOUR WHEEL DRIVE AUTO COMPANY . CLINTONVILLE
FRAM CORPORATION . . . . . PROVIDENCE
FRANTZ COMPANY, S. G. . . . . NEW YORK
FRICK-GALLAGHER MANUFACTURING COMPANY . . . . . WELLSTON
FRIGIDAIRE DIVISION, GMC . . . . . DAYTON
FRUEHAUF TRAILER COMPANY . . . . . DETROIT
FULLER BRUSH COMPANY . . . . . HARTFORD
FURNAS ELECTRIC COMPANY . . . . . BATAVIA

GABRIEL COMPANY . . . . . CLEVELAND
GAIR COMPANY, ROBERT . . . . . NEW YORK
GARY STEEL PRODUCTS CORPORATION . . NORFOLK
GATES RUBBER COMPANY . . . . . DENVER
GAZDA ENGINEERING . . . . . PROVIDENCE
GEAR GRINDING MACHINE COMPANY . . . DETROIT
GEMEX COMPANY . . . . . UNION
GEMMER MANUFACTURING COMPANY . . . DETROIT

Honor Roll of Industrial Preparedness

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GENERAL AMERICAN TRANSPORTATION CORPORATION . . . . . CHICAGO
GENERAL ANILINE & FILM CORPORATION . NEW YORK
GENERAL DYESTUFF CORPORATION . . NEW YORK
GENERAL ELECTRIC COMPANY . . . SCHENECTADY
GENERAL FIREPROOFING COMPANY . YOUNGSTOWN
GENERAL INSTRUMENT CORPORATION . . ELIZABETH
GENERAL MOTORS CORPORATION . . . . DETROIT
GENERAL MOTORS TRUCK & COACH DIVISION, GMC . . . . . PONTIAC
GENERAL STEEL CASTINGS CORPORATION . EDDYSTONE
GENERAL STEEL PRODUCTS CORPORATION . FLUSHING
GENERAL TEXTILE MILLS, INC. . . . . NEW YORK
GENERAL TIME INSTRUMENTS CORP. . . NEW YORK
GENERAL TIRE & RUBBER COMPANY . . . AKRON
GERITY-MICHIGAN CORPORATION . . . . ADRIAN
GEROTOR MAY CORPORATION . . . . BALTIMORE
GERSTENSLAGER COMPANY . . . . . WOOSTER
GIDDINGS & LEWIS MACHINE TOOL COMPANY . . . . . FOND DU LAC
GILBERT & BARKER MANUFACTURING COMPANY . . . . . SPRINGFIELD
GILLETTE SAFETY RAZOR COMPANY . . . BOSTON
GISHOLT MACHINE COMPANY . . . . MADISON
GIVEN MACHINERY COMPANY . . . LOS ANGELES
GLADD BROTHERS, INC. . . . . SARANAC LAKE
GLEASON WORKS . . . . . ROCHESTER
GLIDDEN COMPANY . . . . . CLEVELAND
GLOBE COMPANY . . . . . CHICAGO
GLOBE-UNION, INC. . . . . MILWAUKEE
GOODRICH COMPANY, B. F. . . . . AKRON
GORHAM MANUFACTURING COMPANY . . PROVIDENCE
GORTON MACHINE COMPANY, GEORGE . . . RACINE
GRAMM TRAILER CORPORATION . . . . DELPHOS
GRANITE CITY STEEL COMPANY . . GRANITE CITY
GREAT LAKES STEEL CORPORATION . . . ECORSE
GREDE FOUNDRIES, INC. . . . . MILWAUKEE
GREENE MANUFACTURING COMPANY . . . RACINE
GREENFIELD TAP & DIE CORPORATION . GREENFIELD
GREIST MANUFACTURING COMPANY . . NEW HAVEN
GRIMES COMPANY, BRADLEY E. . . . WEST COLLINGSWOOD HEIGHTS
GULF OIL CORPORATION . . . . . PITTSBURGH

H & B AMERICAN MACHINE COMPANY . . PAWTUCKET
HAINES GAUGE COMPANY . . . . PHILADELPHIA
HANLON & WILSON COMPANY . . . . PITTSBURGH
HANNIFIN CORPORATION . . . . . CHICAGO
HARNISCHFEGER CORPORATION . . . MILWAUKEE
HARRINGTON & RICHARDSON ARMS COMPANY . . . . . WORCESTER
HARRINGTON-WILSON-BROWN COMPANY . NEW YORK
HARRISBURG STEEL CORPORATION . . . HARRISBURG
HARRIS-SEYBOLD COMPANY . . . . CLEVELAND
HARSHAW CHEMICAL COMPANY . . . CLEVELAND
HARVEY MACHINE COMPANY . . . . TORRANCE
HAYES, INC., C. I. . . . . PROVIDENCE
HAYS MANUFACTURING COMPANY . . . . . ERIE
HEBARD & COMPANY, W. F. . . . . CHICAGO
HEIL COMPANY . . . . . MILWAUKEE
HEINEMANN ELECTRIC COMPANY . . . . TRENTON
HEINTZ MANUFACTURING COMPANY . PHILADELPHIA
HELTZEL STEEL FORM & IRON COMPANY . . WARREN
HENDEY MACHINE COMPANY . . . . TORRINGTON
HENDRICK MANUFACTURING COMPANY CARBONDALE
HENRY & WRIGHT MANUFACTURING COMPANY . . . . . HARTFORD
HEPPENSTALL COMPANY . . . . . PITTSBURGH
HERCULES BODY COMPANY . . . . . EVANSVILLE
HERCULES MOTORS CORPORATION . . . . CANTON
HERCULES POWDER COMPANY . . . . WILMINGTON
HERCULES STEEL PRODUCTS CORPORATION . GALION
HEYDEN CHEMICAL CORPORATION . . . NEW YORK
HIGH SPEED HAMMER COMPANY . . . ROCHESTER
HOBART MANUFACTURING COMPANY . . . . TROY
HOE & COMPANY, R. . . . . NEW YORK
HOFMANN & COMPANY, ALFRED . WEST NEW YORK
HOLCOMB & HOKE MANUFACTURING COMPANY . . . . . INDIANAPOLIS
HOLLINGSHEAD CORPORATION, R. M. . . . CAMDEN
HOOSAC MILLS CORPORATION . . . . . BOSTON
HOOVER COMPANY . . . . . NORTH CANTON
HOUGHTON & COMPANY, E. F. . . . PHILADELPHIA
HOWELL COMPANY . . . . . ST. CHARLES
HUDSON MOTOR CAR COMPANY . . . . DETROIT
HUGHES AIRCRAFT COMPANY . . . . CULVER CITY
HUGHES TOOL COMPANY . . . . . HOUSTON
HUNTER CORPORATION, E. V. . . . . STOWE
HUPP CORPORATION . . . . . DETROIT
HUTCHENS METAL PRODUCTS, INC. . SPRINGFIELD
HYATT BEARINGS DIVISION, GMC . . . HARRISON
HYDRO MANUFACTURING COMPANY . . . DETROIT

INDIANA LIMESTONE COMPANY . . . . BEDFORD
INDUSTRIAL RUBBER GOODS COMPANY . ST. JOSEPH
INLAND MANUFACTURING DIVISION, GMC . . DAYTON
INLAND STEEL COMPANY . . . . . CHICAGO
INTERCHEMICAL CORPORATION . . . NEW YORK
INTERNATIONAL BUSINESS MACHINES CORPORATION . . . . . NEW YORK
INTERNATIONAL CHAIN & MANUFACTURING COMPANY . . . . . YORK
INTERNATIONAL DETROLA CORPORATION . . DETROIT
INTERNATIONAL HARVESTER COMPANY . . CHICAGO
INTERNATIONAL NICKEL COMPANY . HUNTINGTON
INTERNATIONAL SILVER COMPANY . . . . MERIDEN
IONIA MANUFACTURING COMPANY . . . . IONIA
ITHACA GUN COMPANY . . . . . ITHACA

JACKSON AND CHURCH COMPANY . . . . SAGINAW
JACKSON INDUSTRIES, INC. . . . . BIRMINGHAM
JACKSONVILLE METAL MANUFACTURING COMPANY . . . . . JACKSONVILLE
JACOBS COMPANY, F. L. . . . . DETROIT
JIG BUSHING COMPANY . . . . . PONTIAC
JOA, INC., CURT G. . . . . SHEBOYGAN

Honor Roll of Industrial Preparedness

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JOHNS-MANVILLE SALES CORPORATION . NEW YORK
JOHNSON AUTOMATICS, INC. . . . . BOSTON
JONES & LAMSON MACHINE COMPANY . SPRINGFIELD
JONES & LAUGHLIN STEEL CORPORATION . PITTSBURGH

KAISER-FRAZER CORPORATION . . . WILLOW RUN
KAYDON ENGINEERING CORPORATION . . MUSKEGON
KEARNEY & TRECKER CORPORATION . . WEST ALLIS
KELLOGG COMPANY, M. W. . . . . NEW YORK
KELLY-SPRINGFIELD TIRE COMPANY . CUMBERLAND
KELSEY-HAYES WHEEL COMPANY . . . . DETROIT
KENNAMETAL, INC. . . . . LATROBE
KENNEDY-VAN SAUN MANUFACTURING & ENGINEERING COMPANY . . . . . DANVILLE
KENWORTH MOTOR TRUCK CORPORATION . . SEATTLE
KEUFFEL & ESSER COMPANY . . . . HOBOKEN
KEYSTONE MANUFACTURING COMPANY . . BOSTON
KIDDE & COMPANY, WALTER . . . . BELLEVILLE
KIFFER TOOL AND DIE, INCORPORATED. . CLEVELAND
KILGORE MANUFACTURING COMPANY . WESTERVILLE
KING-SEELEY CORPORATION . . . . ANN ARBOR
KINGSBURY MACHINE TOOL CORPORATION . KEENE
KNAPP-MONARCH COMPANY . . . . ST. LOUIS
KOEHRING COMPANY . . . . . MILWAUKEE
KOHLER COMPANY . . . . . KOHLER
KOPPERS COMPANY . . . . . PITTSBURGH

LAKE CITY MALLEABLE IRON COMPANY . CLEVELAND
LANOVA CORPORATION . . . . LONG ISLAND CITY
LANSDOWNE STEEL & IRON COMPANY . . . MORTON
LAPOINTE MACHINE TOOL COMPANY . . . HUDSON
LARGE LUMBER COMPANY, FRED R. . . ROCHESTER
LEBANON STEEL FOUNDRY . . . . . LEBANON
LEE TIRE & RUBBER COMPANY OF NEW YORK, INC. . . . . CONSHOHOCKEN
LEEDS & NORTHRUP COMPANY . . . PHILADELPHIA
LEHIGH FOUNDRIES, INC. . . . . EASTON
LIEBERKNECHT, INC., KARL . . . . . READING
LIMA-HAMILTON CORPORATION . . . . LIMA
LINCOLN BRASS WORKS, INC. . . . . DETROIT
LINCOLN ELECTRIC COMPANY . . . . CLEVELAND
LINCOLN ENGINEERING COMPANY . . . ST. LOUIS
LINE MATERIAL COMPANY . . . . . MILWAUKEE
LINK-BELT COMPANY . . . . . CHICAGO
LUKENS STEEL COMPANY . . . . COATESVILLE
LYNCHBURG FOUNDRY COMPANY . . . LYNCHBURG

MACK MANUFACTURING CORPORATION . NEW YORK
MADDOX FOUNDRY & MACHINE WORKS, INC. . ARCHER
MANSFIELD TIRE & RUBBER COMPANY . . MANSFIELD
MARLIN-ROCKWELL CORPORATION . . . JAMESTOWN
MARMON-HERRINGTON COMPANY . . INDIANAPOLIS
MASLAND & SONS, C. H. . . . . CARLISLE
MASON & HANGER COMPANY . . . . NEW YORK
MASON COMPANY, SILAS. . . . . SHREVEPORT
MATHEWS CONVEYOR COMPANY . . ELLWOOD CITY
MAXSON CORPORATION, W. L. . . . . NEW YORK
MCCAULEY METAL PRODUCTS, INC. . . . BUFFALO
MCCONWAY & TORLEY CORPORATION . . PITTSBURGH
MCDOWELL MANUFACTURING COMPANY . PITTSBURGH
MCINERNEY SPRING & WIRE COMPANY GRAND RAPIDS
MCKAY COMPANY . . . . . PITTSBURGH
MCQUAY-NORRIS MANUFACTURING COMPANY ST. LOUIS
MECHANICAL HANDLING SYSTEMS, INC. . . DETROIT
MELCHOIR, ARMSTRONG, DESSAU COMPANY OF DELAWARE, INC. . . . . RIDGEFIELD
MERCK & COMPANY . . . . . RAHWAY
MERGENTHALER LINOTYPE COMPANY . . BROOKLYN
MERZ ENGINEERING COMPANY . . . INDIANAPOLIS
METAL PRODUCTS CORPORATION . . . . MIAMI
METROLOY CORPORATION . . . . NEW ROCHELLE
MEYER MANUFACTURING COMPANY, GEO. J. . . . . CUDAHY
MICA INSULATOR COMPANY . . . . NEW YORK
MICHIGAN STEEL CASTING COMPANY . . . DETROIT
MIDVALE COMPANY . . . . . PHILADELPHIA
MIDWEST PIPING AND SUPPLY COMPANY . ST. LOUIS
MILCO UNDERGARMENT COMPANY . . BLOOMSBURG
MILLER ELECTRIC COMPANY . . . JACKSONVILLE
MILLER MANUFACTURING COMPANY . . . DETROIT
MILLER PRINTING MACHINERY COMPANY . PITTSBURGH
MILSCO MANUFACTURING COMPANY . . MILWAUKEE
MINES EQUIPMENT COMPANY . . . . ST. LOUIS
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY . . . . . MINNEAPOLIS
MINNEAPOLIS-MOLINE POWER IMPLEMENT COMPANY . . . . . MINNEAPOLIS
MISSISSIPPI RIVER FUEL CORPORATION . ST. LOUIS
MONARCH ALUMINUM MANUFACTURING COMPANY . . . . . CLEVELAND
MONARCH RUBBER COMPANY . . . . HARTVILLE
MONITOR CONTROLLER COMPANY . . . . BOSTON
MONROE AUTO EQUIPMENT COMPANY . . . MONROE
MONROE CALCULATING MACHINE COMPANY . ORANGE
MONTGOMERY ELEVATOR COMPANY . . . MOLINE
MONTPELIER MANUFACTURING COMPANY . MONTPELIER
MOORE ENAMELING & MANUFACTURING COMPANY . . . . . WEST LAFAYETTE
MOREY MACHINERY COMPANY . . . . NEW YORK
MORRISON STEEL PRODUCTS, INC. . . . . BUFFALO
MOSLER SAFE COMPANY . . . . . HAMILTON
MOTOR WHEEL CORPORATION . . . . . LANSING
MULLINS MANUFACTURING CORPORATION . . SALEM
MUNCIE GEAR WORKS, INC. . . . . MUNCIE
MUNSINGWEAR, INC. . . . . MINNEAPOLIS
MURRAY OHIO MANUFACTURING COMPANY CLEVELAND

NAGEL-CHASE MANUFACTURING COMPANY . CHICAGO
NARROW FABRIC COMPANY . . . . . READING
NASH ENGINEERING COMPANY . . SOUTH NORWALK
NASH-KELVINATOR CORPORATION . . . . DETROIT
NASHUA GUMMED AND COATED PAPER COMPANY NASHUA
NATIONAL ACME COMPANY . . . . . CLEVELAND
NATIONAL ASSOCIATION OF INSURANCE AGENTS . . . . . NEW YORK
NATIONAL AUTOMOTIVE FIBRES, INC. . . . DETROIT

Honor Roll of Industrial Preparedness

S

NATIONAL BROACH & MACHINE COMPANY . . DETROIT
NATIONAL ENAMELING & STAMPING COMPANY . . . . . MILWAUKEE
NATIONAL LOCK WASHER COMPANY . . . NEWARK
NATIONAL MACHINERY COMPANY . . . . TIFFIN
NATIONAL MALLEABLE & STEEL CASTINGS COMPANY . . . . . CLEVELAND
NATIONAL PNEUMATIC COMPANY . . . . RAHWAY
NATIONAL POWDER COMPANY . . . . . ELDRED
NATIONAL SCREW & MANUFACTURING COMPANY . . . . . CLEVELAND
NATIONAL SLUG REJECTORS, INC. . . . ST. LOUIS
NATIONAL STAMPING & ELECTRIC WORKS . . CHICAGO
NATIONAL SUPPLY COMPANY . . . . PITTSBURGH
NATIONAL TUBE COMPANY . . . . . PITTSBURGH
NELSON SPECIALTY WELDING EQUIPMENT CORPORATION . . . . . SAN LEANDRO
NEW BRITAIN MACHINE COMPANY . . NEW BRITAIN
NEW ENGLAND BOX COMPANY . . . . GREENFIELD
NEW ENGLAND BRASS COMPANY . . . TAUNTON
NEW PROCESS GEAR CORPORATION . . SYRACUSE
NEW YORK AIR BRAKE COMPANY . . . NEW YORK
NEWARK STOVE COMPANY . . . . . NEWARK
NIEDRINGHAUS METAL PRODUCTS COMPANY . . . . . ST. LOUIS
NINETEEN HUNDRED CORPORATION . . ST. JOSEPH
NOLL EQUIPMENT COMPANY . . . . CLEVELAND
NORDBERG MANUFACTURING COMPANY . MILWAUKEE
NORQUIST PRODUCTS, INC. . . . . JAMESTOWN
NORRIS STAMPING & MANUFACTURING COMPANY . . . . . LOS ANGELES
NORTHWEST AUTOMATIC PRODUCTS CORPORATION . . . . . MINNEAPOLIS
NORTON COMPANY . . . . . WORCESTER

OAKITE PRODUCTS, INC. . . . . NEW YORK
OCEAN CITY MANUFACTURING COMPANY PHILADELPHIA
OHIO FALLS DYE & FINISHING WORKS . LOUISVILLE
OHIO RUBBER COMPANY . . . . WILLOUGHBY
OHIO STEEL FOUNDRY COMPANY . . . . LIMA
OILGEAR COMPANY . . . . . MILWAUKEE
O'KEEFE & MERRITT COMPANY . . . LOS ANGELES
OLD TRAIL MOTORS, INC. . . . . WASHINGTON
OLDSMOBILE DIVISION, GMC . . . . LANSING
OLIN INDUSTRIES, INC. . . . . EAST ALTON
OLIVER CORPORATION . . . . . CHICAGO
OLIVER IRON AND STEEL CORPORATION . PITTSBURGH
OLSON MANUFACTURING COMPANY . . . BOISE
ONONDAGA POTTERY COMPANY . . . SYRACUSE
OPW CORPORATION . . . . . CINCINNATI
ORLEANS MATERIALS & EQUIPMENT COMPANY . . . . . NEW ORLEANS
OTIS ELEVATOR COMPANY . . . . . NEW YORK
OWENS-ILLINOIS GLASS COMPANY . . . . TOLEDO

PACIFIC CAR AND FOUNDRY COMPANY . . RENTON
PACKARD MOTOR CAR COMPANY . . . . DETROIT
PARISH PRESSED STEEL COMPANY . . . . READING
PARKER RUST-PROOF COMPANY . . . . DETROIT
PARR PAINT & COLOR COMPANY . . . CLEVELAND
PASS & SEYMOUR, INC. . . . . SYRACUSE
PECO MANUFACTURING CORPORATION . PHILADELPHIA
PEMCO CORPORATION . . . . . BALTIMORE
PERFEX CORPORATION . . . . . MILWAUKEE
PFIZER & COMPANY, CHARLES . . . . NEW YORK
PHELPS DODGE COPPER PRODUCTS CORPORATION . . . . . NEW YORK
PHEOLL MANUFACTURING COMPANY . . . CHICAGO
PITTSBURGH FORGINGS COMPANY . . . CORAPOLIS
PITTSBURGH STEEL COMPANY . . . . PITTSBURGH
PLUMB, INC., FAYETTE R. . . . . PHILADELPHIA
PLUME & ATWOOD MANUFACTURING COMPANY . . . . . WATERBURY
PLYMOUTH MOTOR CORPORATION . . . . DETROIT
POLORON PRODUCTS, INC. . . . . NEW ROCHELLE
PONTIAC MOTOR DIVISION, GMC . . . . PONTIAC
PONTIAC VARNISH COMPANY . . . . . PONTIAC
POPPER, INC., J. S. . . . . UNION CITY
PORTER COMPANY, H. K. . . . . PITTSBURGH
PRECISION CASTINGS COMPANY . . . SYRACUSE
PRENTISS WABERS PRODUCTS COMPANY . . . . . WISCONSIN RAPIDS
PRESSED STEEL CAR COMPANY . . . . PITTSBURGH
PROCTER & GAMBLE COMPANY . . . . CINCINNATI
PULLMAN-STANDARD CAR MANUFACTURING COMPANY . . . . . CHICAGO

QUALITY GASKET & MANUFACTURING COMPANY . . . . . DETROIT

RATHBORNE HAIR & RIDGWAY COMPANY . . CHICAGO
RAYNER LITHOGRAPHING COMPANY . . . CHICAGO
RCA VICTOR DIVISION, RADIO CORP. OF AMERICA . . . . . CAMDEN
REEVES BROTHERS, INC. . . . . NEW YORK
REEVES INSTRUMENT CORPORATION . . NEW YORK
REGINA CORPORATION . . . . . RAHWAY
REMINGTON ARMS COMPANY . . . . BRIDGEPORT
REMINGTON RAND, INC. . . . . STAMFORD
REO MOTORS, INC. . . . . LANSING
REPUBLIC STAMPING & ENAMELING COMPANY . . . . . OANTON
REPUBLIC STEEL CORPORATION . . . CLEVELAND
REVERE COPPER & BRASS, INC. . . . NEW YORK
REYNOLDS METALS COMPANY . . . . RICHMOND
REYNOLDS SPRING COMPANY . . . . JACKSON
RHEEM MANUFACTURING COMPANY . . NEW YORK
RICHMOND ENGINEERING COMPANY . . RICHMOND
ROBBINS ENGINEERING COMPANY . . . . DETROIT
ROBERTSHAW-FULTON CONTROLS COMPANY . . . . . GREENSBURG
ROSS GEAR AND TOOL COMPANY . . . LAFAYETTE
ROSS-MEEHAN FOUNDRIES . . . . CHATTANOOGA
ROYAL TYPEWRITER COMPANY . . . . HARTFORD
RUDEL MACHINERY COMPANY . . . . NEW YORK
RUSSELL MANUFACTURING COMPANY . . MIDDLETON

Honor Roll of Industrial Preparedness

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RUSTLESS IRON & STEEL DIVISION, ARMCO STEEL CORPORATION . . . . . BALTIMORE

SAE STEELS . . . . . CLEVELAND
SAGINAW MALLEABLE IRON DIVISION, GMC SAGINAW
SAGINAW STEERING GEAR DIVISION, GMC . SAGINAW
ST. LOUIS CAR COMPANY . . . . . ST. LOUIS
SALEM ENGINEERING COMPANY . . . . . SALEM
SANDERSON & PORTER . . . . . NEW YORK
SANDPAPER INCORPORATED . . . . . ROCKLAND
SAVAGE ARMS CORPORATION . . . . . UTICA
SCAIFE COMPANY . . . . . OAKMONT
SCHLAGE LOCK COMPANY . . . . . SAN FRANCISCO
SCHLEGEL MANUFACTURING COMPANY . ROCHESTER
SCHLITZ BREWING COMPANY, JOSEPH . . MILWAUKEE
SCHLUETER MANUFACTURING COMPANY . ST. LOUIS
SCHWITZER-CUMMINS COMPANY . . INDIANAPOLIS
SCOVILL MANUFACTURING COMPANY . . WATERBURY
SCULLIN STEEL COMPANY . . . . . ST. LOUIS
SEEGER REFRIGERATOR COMPANY . . . . ST. PAUL
SELMER, INC., H. & A. . . . . NEW CASTLE
SERVEL, INC. . . . . EVANSVILLE
SERVO CORPORATION OF AMERICA . . LINDENHURST
SEYMOUR PRODUCTS COMPANY . . . . SEYMOUR
SHEAFFER PEN COMPANY, W. A. . . FORT MADISON
SHEFFIELD CORPORATION . . . . . DAYTON
SHELL OIL COMPANY . . . . . DETROIT
SHERWIN-WILLIAMS COMPANY . . . . CLEVELAND
SILENT GLOW OIL BURNER CORPORATION . HARTFORD
SIMMONS COMPANY . . . . . NEW YORK
SIMONDS SAW & STEEL COMPANY . . . FITCHBURG
SIMPLEX MANUFACTURING CORPORATION NEW ORLEANS
SINGER MANUFACTURING COMPANY . ELIZABETHPORT
SIVYER STEEL CASTING COMPANY . . . MILWAUKEE
SKF INDUSTRIES, INC. . . . . PHILADELPHIA
SMIT & COMPANY, ANTON . . . . . NEW YORK
SMITH CORPORATION, A. O. . . . . MILWAUKEE
SMITH, DRUM & COMPANY . . . . PHILADELPHIA
SMITH & WESSON, INC. . . . . SPRINGFIELD
SMITH MANUFACTURING COMPANY, F. A. . ROCHESTER
SNYDER MANUFACTURING COMPANY, H. P. LITTLE FALLS
SORENG MANUFACTURING CORPORATION . . CHICAGO
SOSS MANUFACTURING COMPANY . . . . DETROIT
SOUTH CHESTER TUBE COMPANY . . . . CHESTER
SOUTHERN COACH MANUFACTURING COMPANY . . . . . EVERGREEN
SPEED-O-PRINT CORPORATION . . . . . CHICAGO
SPENCER CHEMICAL COMPANY . . . KANSAS CITY
SPERRY GYROSCOPE COMPANY . . . . GREAT NECK
SPICER MANUFACTURING DIVISION, DANA CORPORATION . . . . . TOLEDO
SPONGE RUBBER PRODUCTS COMPANY . . . SHELTON
SQUARE D COMPANY . . . . . DETROIT
STANDARD CONTAINER, INC. . . . . MONTCLAIR
STANDARD FORGINGS CORPORATION . . . CHICAGO
STANDARD MOTOR PRODUCTS, INC. LONG ISLAND CITY
STANDARD PRESSED STEEL COMPANY . JENKINTOWN
STANDARD PRODUCTS COMPANY . . . . DETROIT
STANDARD RAILWAY EQUIPMENT MANUFACTURING COMPANY . . . . . CHICAGO
STANDARD STEEL SPRING COMPANY . . CORAOPOLIS
STANDARD STOKER COMPANY . . . . NEW YORK
STANDARD TUBE COMPANY . . . . . DETROIT
STEARNS-ROGER MANUFACTURING COMPANY . DENVER
STEEL COOPERAGE COMPANY . . . . . DETROIT
STERLING MOTOR TRUCK COMPANY . . MILWAUKEE
STOCKHAM PIPE FITTINGS COMPANY . BIRMINGHAM
STONE & WEBSTER ENGINEERING CORPORATION . . . . . NEW YORK
STRATFORD ENGINEERING CORPORATION KANSAS CITY
STREICHER DIE & TOOL COMPANY . . . YPSILANTI
STRELINGER COMPANY, CHAS. A. . . . . DETROIT
STUART OIL COMPANY, D. A. . . . . CHICAGO
STUDEBAKER CORPORATION . . . . SOUTH BEND
SUN OIL COMPANY . . . . . PHILADELPHIA
SUPERIOR COACH CORPORATION . . . . . LIMA
SURFACE COMBUSTION CORPORATION . . . TOLEDO
SUSQUEHANNA MILLS, INC. . . . . NEW YORK
SWANK, INC. . . . . ATTLEBORO
SYMINGTON-GOULD CORPORATION . . . ROCHESTER

TABER INSTRUMENT CORPORATION . NORTH TONAWANDA
TALON, INC. . . . . MEADVILLE
TENNESSEE COAL, IRON AND RAILROAD COMPANY . . . . . BIRMINGHAM
TENNESSEE CORPORATION . . . . . NEW YORK
TEXAS GULF SULPHUR COMPANY . . . NEW YORK
TEXTILE MACHINE WORKS . . . . . READING
THEW SHOVEL COMPANY . . . . . LORAIN
THOMPSON PRODUCTS, INC. . . . . CLEVELAND
TIMKEN-DETROIT AXLE COMPANY . . . . DETROIT
TIMKEN ROLLER BEARING COMPANY . . . CANTON
TIMMS SPRING COMPANY . . . . . ELYRIA
TITAN METAL MANUFACTURING COMPANY BELLEFONTE
TITEFLEX, INC. . . . . NEWARK
TOKHEIM OIL TANK AND PUMP COMPANY FORT WAYNE
TRAILMOBILE COMPANY . . . . . CINCINNATI
TREADWELL CONSTRUCTION COMPANY . . MIDLAND
TRICO PRODUCTS CORPORATION . . . . BUFFALO
TROJAN POWDER COMPANY . . . . . ALLENTOWN
TROPIC-AIRE, INC. . . . . CHICAGO
TULSA WINCH DIVISION, VICKERS, INC. . . TULSA
TURNER BRASS WORKS . . . . . SYCAMORE
TWIN DISC CLUTCH COMPANY . . . . . RACINE

UNDERWOOD CORPORATION . . . . . NEW YORK
UNEXCELLED CHEMICAL CORPORATION . NEW YORK
UNION CARBIDE AND CARBON CORP. . . NEW YORK
UNION METAL MANUFACTURING COMPANY . CANTON
UNION SWITCH & SIGNAL COMPANY . . SWISSVALE
UNITED AIRCRAFT CORPORATION . . EAST HARTFORD
UNITED-CARR FASTENER CORPORATION . CAMBRIDGE
UNITED CHROMIUM, INCORPORATED . . NEW YORK
UNITED ENGINEERING & FOUNDRY CO. . PITTSBURGH
UNITED METAL BOX COMPANY . . . . . BROOKLYN
UNITED MOTORS SERVICE DIV., GMC . . . DETROIT

Honor Roll of Industrial Preparedness

UNITED SHOE MACHINERY CORPORATION . . BOSTON
UNITED SPECIALTIES COMPANY . . . . CHICAGO
UNITED STATES PIPE AND FOUNDRY COMPANY . . . . . BURLINGTON
UNITED STATES RUBBER COMPANY . . . NEW YORK
UNITED STATES STEEL CORPORATION OF DELAWARE . . . . . PITTSBURGH
UNITED STATES STEEL SUPPLY COMPANY . . CHICAGO
UNITED TRANSPORTS, INC. . . . . OKLAHOMA CITY

VAN DORN IRON WORKS COMPANY . . CLEVELAND
VANCE COMPANY, J. A. . . . . WINSTON-SALEM
VEEDER-ROOT, INC. . . . . HARTFORD
VERSON ALLSTEEL PRESS COMPANY . . . CHICAGO
VICKERS, INC. . . . . DETROIT
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The National Divisions, A.O.A.

ARTILLERY DIVISION

The executive board of this Division held a 2-day meeting at Rock Island Arsenal, Ill., on August 10 and 11, 1948, with its chairman, J. E. Trainer, presiding. It was an excellent meeting with all questions presented being very thoroughly discussed.

At the last meeting of this executive board, held at the Watertown Arsenal in January of this year, consideration was given to the utilization of Phase I and Phase II planning contracts as applied to artillery equipment. At that time the board recommended to the Chief of Ordnance a number of important artillery items which they believed should be covered by these planning studies. The progress and scope of these studies were carefully reviewed at the meeting at Rock Island Arsenal, and comments and recommendations were made for the most effective future use of these planning contracts with industry.

Probably the most interesting discussion of this meeting centered around the Ordnance Department's postwar development of lightweight artillery carriages required for airborne operations. Lightweight materials are employed to a considerable extent in these new types of carriages, and the use of such materials came in for considerable discussion during the course of the meeting.

The board members also found time during the meeting to visit the laboratories, proving ground, manufacturing shops, and storehouses of the arsenal. The members expressed great interest in the methods which have been developed for the effective preservation of artillery matériel in long-time storage.

J. E. Galvin, president of the Ohio Steel Foundry Company of Lima, Ohio, has recently been appointed a member of the executive board of this Division.

SMALL ARMS AND SMALL ARMS AMMUNITION DIVISION

C. K. Davis, chairman, has recently received a letter from the Chief of Ordnance requesting that the appropriate committees of the Division study and comment upon some of the Ordnance Department's postwar developments of small-arms matériel. The joint consideration of this newly developed equipment by the A.O.A. Technical Advisory Committees from a mass-production standpoint and by the Ordnance engineers who have been engaged on the developments from the standpoint of required military characteristics should contribute materially to effective industrial preparedness for small-arms matériel.

LEGAL COMMITTEE

Proposed procurement policies of the armed services were the principal topic of analysis on September 9 and 10, 1948, in New York City when W. L. Clay, secretary of the Small Arms and Small Arms Ammunition Division, held a meeting of a special Legal Committee composed of members of the various commodity committees of the Small Arms and Small Arms Ammunition Division.

Several representatives of national headquarters, A.O.A., including James L. Walsh, president, and John Ross Delafield, general counsel, were present during part of the deliberations of this committee. Col. James F. Hanley of the Judge Advocate General's Office of the Army and Maj. W. W. Thybony of the Logistics Division, General Staff of the Army, also were present.

Fifteen committee members were on hand for this meeting from the Small Arms and Small Arms Ammunition Division. The purpose of this meeting was to consider the new Joint Army, Navy, and Air Force procurement regulations now under preparation.

During the first day the committee questioned the Army representatives in great detail concerning the various features of the new regulations, especially in those cases where changes had been made from the regulations and procedures in effect during World War II. The Army representatives made a very able presentation, and the civilian representatives seemed to be more than pleased with this frank discussion between Army and industry on these legal contractual matters. On the second day the committee members discussed general policies and procedures, resulting in the formation of three subcommittees as follows:

Patents Subcommittee under the chairmanship of Edwin Pugsley, vice-president, Winchester Repeating Arms Company, to consider patent features of both research and development and supply contracts.

Contract Provisions Subcommittee under the chairmanship of R. H. Spreen, Legal Division, General Motors Corporation, to consider all contract provisions other than patent clauses in both research and development and supply contracts.

Renegotiation, Cost Redetermination, and Cost Principles Subcommittee under the chairmanship of M. M. Evans, assistant treasurer, Remington Arms Company.

ROCKET, BOMB, AND ARTILLERY AMMUNITION DIVISION

The initial meeting of the Container Committee was held in the Office of the Field Director of Ammunition Plants, Joliet Arsenal, Ill., on September 16 and 17, 1948. The chairman of this committee, Dr. G. W. Mulder, had been in charge of this type of work in the Office of the Field Director of Ammunition Plants at St. Louis, Mo., during World War II.

In addition, all members of this committee had either served in the Ordnance Department during the war or were affiliated with commercial companies which performed container work for the Ordnance Department, so that the committee was particularly well informed on all matters pertaining to ammunition containers.

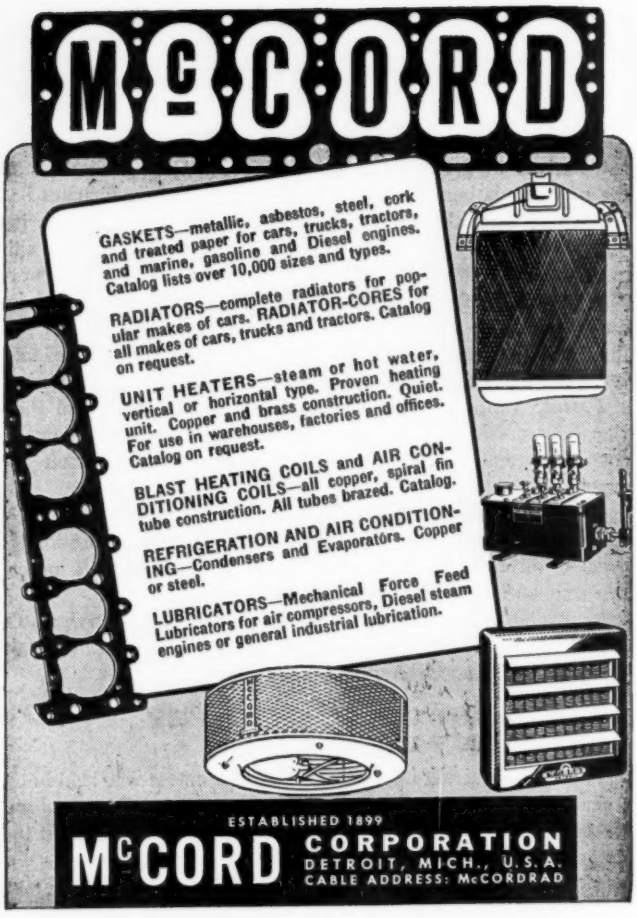
Col. Joel G. Holmes, Field Director of Ammunition Plants of the Ordnance Department, and Lieut. Col. R. C. Costabile, commanding officer of Joliet Arsenal, were in charge of arrangements, and both attended the committee meeting. Representatives were also present from the Bureau of Ordnance, Navy; Office of the Chief of Ordnance, Army; Picatinny Arsenal, N. J.; Frankford Arsenal, Pa.; and from the Ordnance Board at the Aberdeen Proving Ground, Md.

The members of the committee were very much interested in learning of the latest thinking and lines of development for ammunition containers since the end of the war. In view of their great familiarity with the subject, this committee plans on making a number of very definite recommendations as to current problems on which they can be of assistance to the armed services.

RENEGOTIATION

The Assistant Secretary of the Air Force, A. S. Barrows, on behalf of the Air Force, Army, and Navy, has requested the Association to comment upon the proposed regulations implementing the Renegotiation Act of 1948. A committee of well-qualified members is studying the proposed regulations, and on the basis of their comments and recommendations a report will be prepared and submitted.

The Association has been honored recently by requests from various elements of the National Defense Establishment for advice in the preparation of proposed policies relating to functional operations of the respective agencies. It is a most encouraging sign that our Association and other industrial groups are asked to serve in these capacities on important defense matters.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Atomic Energy

URANIUM IN POLAND

Poles are feverishly developing what their government regards as Europe's second largest deposit of uranium, a basic element of the atomic bomb.

A large mine, in operation in Lower Silesia sixty-two miles southwest of Breslau, is closely restricted and is said to employ 1,200 men. The Poles have been exploiting the find since 1946.

MEDICAL ATOM BOMBS

The possibility of planting and exploding tiny atom bombs to wipe out localized concentrations of disease has been raised by experiments of that kind on animals. Small amounts of uranium 235 were injected into three white mice at Oak Ridge, Tenn. Later the mice were put briefly within range of a neutron beam. The neutrons caused the uranium atoms to explode, resulting in tissue changes in the mice.

MULTIBILLION VOLT SYNCHROTRON

The United States Atomic Energy Commission will finance the construction of a 30-foot multibillion-volt proton synchrotron or high-energy electronuclear machine to be built at Brookhaven National Laboratory, Upton, Long Island. Construction of the accelerator, the largest in the East, will take approximately three years. The new machine will produce, under controlled laboratory conditions, high-energy protons, the primary cosmic particles which constantly penetrate the earth's atmosphere. By causing these high-energy protons to bombard hydrogen atoms, for example, it will be possible to produce both light and heavy mesons in the same manner as these particles are made by cosmic rays.

NEW ATOM SMASHER

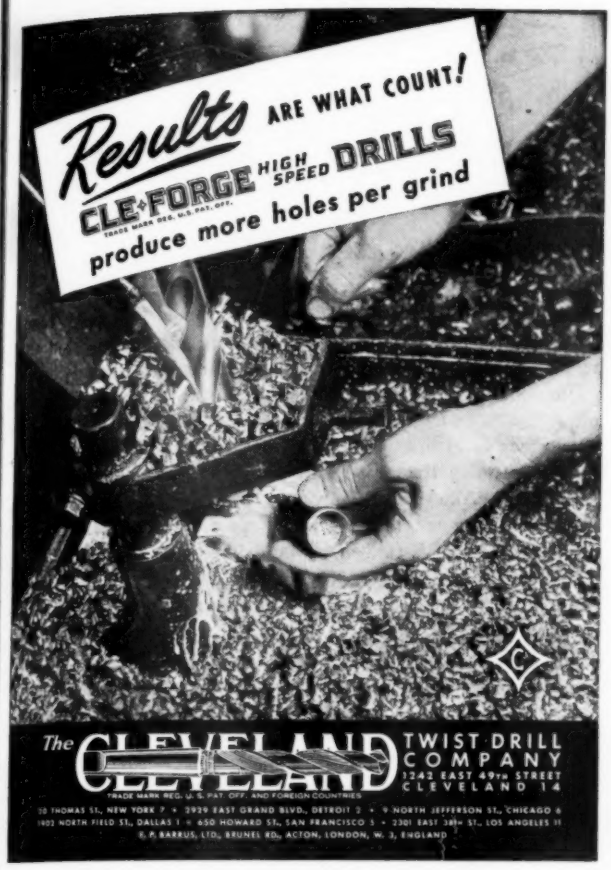
Utilizing a new atom-smashing linear accelerator, Yale University physicists have attained energies of one million volts and expect eventually to unlock new nuclear secrets. The device smashes the nucleus by using the electron—the light, negatively charged particle of the atom—rather than employing the heavier neutrons and protons.

Operation of the linear accelerator involves the firing of electron particles in a straight line through a series of round, hollow "pillboxes" made of steel and lined with copper to provide a maximum of conductivity. Weighing about seventy-five pounds, the "pillboxes" are connected by small holes and are from three to seven inches long. The Yale system is powered by coupling the "pillboxes" to high-powered amplifiers and synchronizing the flow of electron particles from a single source.

ATOMIC MEDICINE

America's major medical offensive against atomic radiation will get under way shortly by the founding of a new kind of medical school. This atomic medical school is a part of the University of Rochester and supported by the Atomic Energy Commission.

The school will take about 100 students at a time. About thirty of them will be taking short courses in health physics, protection techniques, and blood chemistry. Another thirty will be college or university graduates studying for doctor of philosophy degrees. The remaining forty will be doctors of medicine, doctors of philosophy, or Army officers.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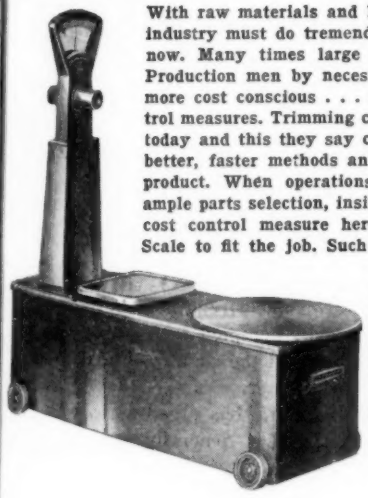

With raw materials and labor costs at all time highs industry must do tremendous volume to show a profit now. Many times large volume is not the answer. Production men by necessity are becoming more and more cost conscious . . . are seeking better cost control measures. Trimming costs means increasing profits today and this they say can only be accomplished by better, faster methods and savings in both time and product. When operations require weighing, for example parts selection, insist on absolute accuracy. The cost control measure here is an EXACT WEIGHT Scale to fit the job. Such equipment assures parts to specifications. Remember a uniform part is what specifications intended it to be, no more no less. Such parts priced in line with other known costs show a profit. Write for complete details for your plant operations.

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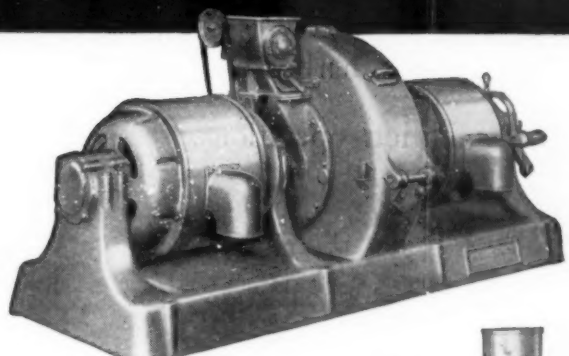

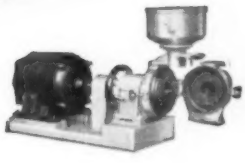

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Communications

REARM OUR ALLIES

THE EDITOR.—In considering the results of an open breach with Russia, it seems to be taken for granted that the French, English, Italian, and Benelux armies are nonexistent and that the ground defense force in Western Europe rests on America.

The English and French armies in World War I put up much better resistance against the Germans than did the Russians. The man power is still there. Why can't we outfit their armies to better advantage than resort to equipping and transporting our armies from America to Europe?

The Russians would be a long way from their base of supplies west of the Vistula and would have considerable difficulty in keeping a very large army equipped there. Why, then, the concession that the defense of Western Europe depends on American infantry and that the Russians could overrun that area at will?

I think many A.O.A. members who have no professional training would be very much interested in having the technical aspects of this problem discussed by experts. I have heard it said that much of the present war talk is due to hysteria or desire of the Army for larger appropriations. If these rumors are unjust and unwarranted much good could be done by such a discussion.

Los Angeles, Calif. A. L. WEIL.

"OUTSTANDING ISSUE"

THE EDITOR.—I believe that your COMMON DEFENSE No. 95 was the most outstanding issue that you have printed in quite a long time. Particularly did your story headed "One of the Star Government Witnesses" interest me. I didn't think it was possible for one to be educated in our American public schools and colleges without obtaining the important fundamentals of Americanism.

Cincinnati, Ohio. J. M. ZEPP.

THE MAN WITH THE BAYONET

THE EDITOR.—In a recent issue of ORDNANCE, Hanson W. Baldwin stated that, "Our economic strength won World War II." That is a feeling too easily accepted by too many people, not only in industry but throughout the country. For the record, we should analyze that a little closer.

From time immemorial the debate has raged as to who won each war, but military doctrine has generally agreed on one thing: It isn't the air force that wins the war, nor industry with its vast production, nor tanks with all their armored firepower, nor any atomic bomb. What does win a war, then? It is the individual soldier armed with a rifle and bayonet who finally closes with the enemy to capture the objective. Not that he could do it alone, but everything else—industry, air force, navy, atomic bomb—all have the primary mission of supporting the soldier, neutralizing the enemy, making the soldier's job easier in the final attack.

I do not wish to quibble over words to argue over who won the wars, but I hope that in all our defense tasks we will keep that one mission in mind and direct our efforts along that line.

Fort Benning, Ga. CAPT. REYNOLD ATLAS.

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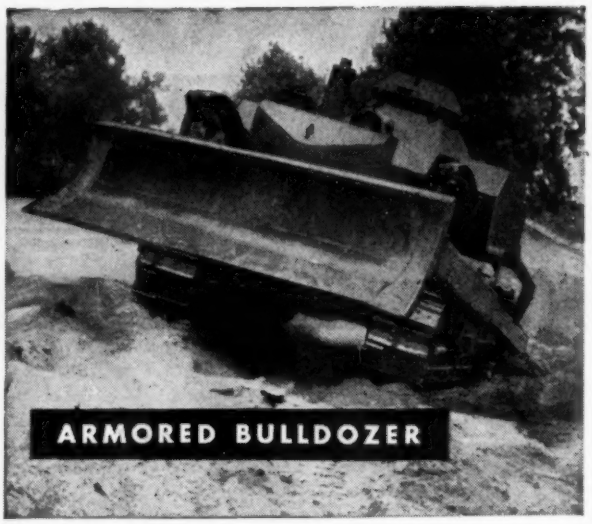

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DR. JOHN J. O'CONNOR, *educator, author, editor, Washington, D. C.*

COL. PHILIP SCHWARTZ, *author, air ordnance expert, Andrews Air Force Base, Md.*

ORDNANCE WENT UP FRONT. By Roy F. Dunlap. Plantersville: Small Arms Technical Publishing Company. 414 pp. $4.

THE author, a wartime sergeant, writes in the foreword to this comprehensive treatise on small arms: "The mechanics of the writing herein aren't very good, I know . . .," and then, no doubt with tongue in cheek, he proceeds to give us as interesting and as colorful a personal journal of war's developments as we have seen in a long time. The experience phase, however, is a vehicle, and a very acceptable one, for his highly expert diagnosis and appraisal of the small arms with which he met up during his war assignments—and he appears to have met a great many of them.

Make no mistake, this man knows his small weapons—their use, their construction, their limitations, their maintenance, and repair—and he has much to say about small-arms ammunition from the very practical viewpoint of the man in the field.

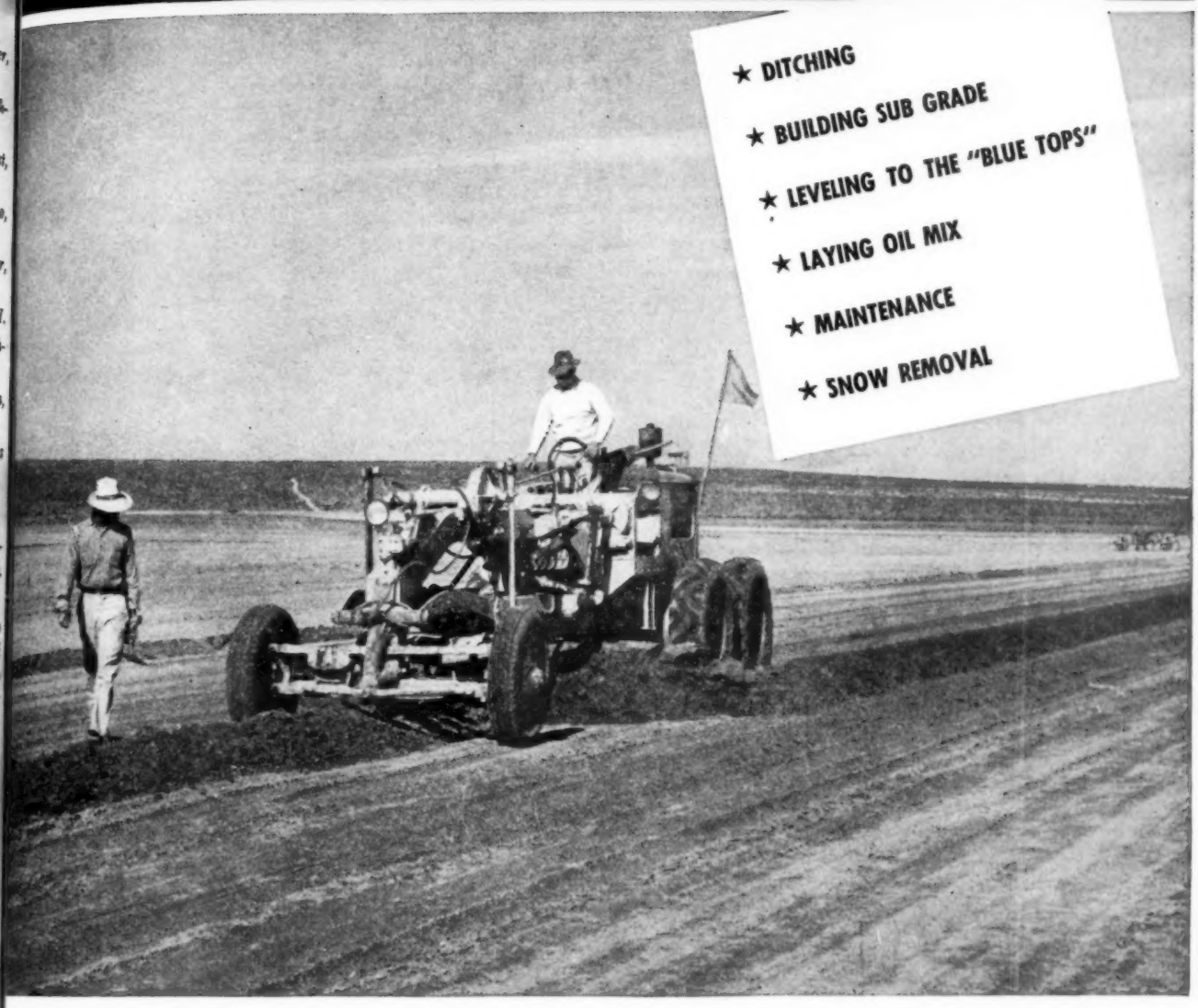
A principal value of this volume lies in its scope. The author not only covers thoroughly United States weapons but those of Britain, France, Belgium, Russia, Germany, Japan, Italy, the Balkan and the North Countries as well. An exhaustive chapter on military rifle actions closes this addition to the growing library of World War II literature.—ROBERT T. GEBLER.

THE ARMY AIR FORCES IN WORLD WAR II (VOL. I—PLANS AND EARLY OPERATIONS). Edited by W. F. Craven and J. L. Cate. Chicago: University of Chicago Press. 788 pp. $5.

THE Office of Air Force History could not have been more timely in its release of this, the first of seven volumes. The formative period (January 1939 to August 1942) is covered. Subsequent volumes, which are to be released at 6-month intervals, will treat of European operations, Pacific operations, and personnel, matériel, and services.

Editors and publishers alike accepted their task on the stipulation of complete academic freedom. That this was liberally used is evidenced by the book's objectivity. From the condensed account of the U. S. air arm before the outbreak of the second

GROUND MISSIONS ACCOMPLISHED



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Book Reviews

World War to the establishment and early missions of the Eighth Air Force, there appears to be no attempt to cover the many errors of the vast undertaking nor to overglorify its achievements.

Official histories are primarily the repository of the great mass of facts from which future historical writers may build. This is much more, for it is immensely more readable than most of its type. Documentation is thorough and concise, thirty-one fine maps and charts and sixty-two photographs are provided, a glossary of abbreviations and code names is included, and the index seems well above the average. The volume should go far in informing our people on an important phase of air-age history.—F. W. F. GLEASON.

TOTAL POWER: A FOOTNOTE TO HISTORY. By Edmund A. Walsh. Garden City: Doubleday & Company. 373 pp. $5.

FATHER WALSH, regent of the School of Foreign Service and vice-president of Georgetown University, has long been recognized as an authority on international affairs. He is here concerned with those geopolitical theories of Karl Haushofer that strongly influenced the Nazi attempt at world domination and are being used today by the Soviets in their similar hunger for world conquest.

In his very able and stimulating critique of the problem of world power, Father Walsh stresses the fact that behind all display of force lies an idea—an idealistic faith of some sort, good or bad—and some form of spiritual exaltation.

The philosophy of world mastery was given to the Germans by a long line of subjectivist philosophers such as Kant, Fichte, Hegel, and Nietzsche who corrupted German thought and made it possible for Hitler to use the power of ideas as justification for his own ideas of power.

So also the Soviet grab for world power can only be understood in terms of the ideas of Marx, Lenin, and Stalin. Haushofer's geopolitical theories have been brought back to life and are being exploited by the present masters of Soviet Russia who already control the heartland of Eurasia.

Father Walsh's brilliant study will interest those who are seeking below the surface of things for an explanation of what is currently happening in our topsy-turvy postwar world.—JOHN J. O'CONNOR.

THE UNITED STATES ARMY IN WORLD WAR II—THE ARMY GROUND FORCES. By R. R. Palmer, B. I. Wiley, and W. R. Keast. Washington: U. S. Government Printing Office. 696 pp. $3.25.

THE second of a projected series of one hundred volumes covering the entire ground warfare of 1941-1945 carries forward the work so well begun with the issue of Vol. I a few months ago.

Necessarily, the work turned out by the Historical Division of the Department of the Army is closely based upon the multitudinous documents which record the administration of a vastly expanded and far-flung organization.

The purpose of an official history is to provide a solid foundation upon which future writers may build, and no amount of wizardry can combine this work with much reader appeal. But human interest has been used wherever feasible and results in a well-balanced volume of reference history.—F. W. F. GLEASON.

BATTLEFRONTS OF INDUSTRY. By David O. Woodbury. New York: John Wiley & Sons, Inc. 342 pp. $3.50.

THIS is a very difficult book to review adequately because the scope of the text embraces a large number of complex subjects which are related to each other only because they all represent contributions to the war efforts of the United Nations by one of America's industrial giants. (*Continued on p. 214*)

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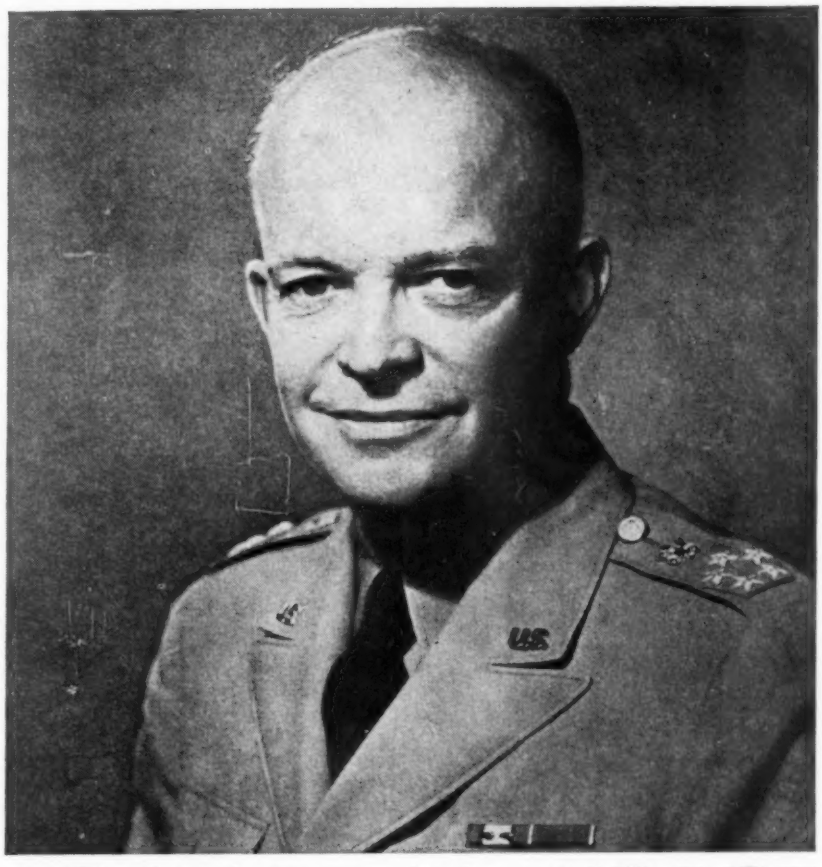

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Book Reviews

To mention at random only a few of the numerous diverse fields in which the Westinghouse Electric Corporation's efforts were of major importance, we may cite the development and production in quantity of gyrostabilizers for tank guns which made it practicable to shoot effectively from moving tanks under battle conditions; its part in the development of radar apparatus sufficiently sensitive to detect an object as small as a 2-seater bomber one hundred miles away; and that of the proximity fuze which, by incorporating a radio sending and receiving set in the nose of a bomb or projectile, turns "near misses" into "hits" on a target.

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An absolute error is to be pointed out in the text. On page 216 the discovery of the "cavity-charge" effect is attributed to D. E. Neville-Monroe of Columbia University, and it is stated that it was kept secret for fear that yeggmen would use it to blow safes. This is an interesting bit of romance. As a matter of fact what is known as the "Munroe effect" was discovered by Dr. Charles E. Munroe and announced publicly in 1888 in an article in *Scribners Magazine*. In 1911, the same discovery was claimed by a German, Egor Neuman. The way the Munroe effect entered our services is a story in itself.—Richard E. Somers.

Under Our Flag—A Tribute to Those Who Served in World War II. Worcester: The Norton Company.

In this beautifully printed and bound volume the Norton Company of Worcester, Mass., memorializes those of its employees who made the supreme sacrifice during World War II.

The method of treatment of the memorial is worthy of public acclaim. The company obtained a picture of each of the men who died in the service during the war; in many cases this was only a small photograph. From these pictures a most capable artist, Miss Bettina Steinke, prepared a large crayon sketch. Each sketch was suitably framed and presented to the next of kin. The presentation was made personally by an executive of the company.

In addition, the volume, "Under Our Flag," was presented, and in it is included a reproduction of each of the sketches in color, together with the war record of each man. The book also includes a list of all employees of the company who served in the U. S. Army, Navy, and Air Force.—L. A. Codd.

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